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1	1	Cog.Eng. G. Singh	[signature]	7/11/96	H6-11	R. Adhakari/L. L. Holleman (ICFKH)	[signature]	7/12/96, 7/15/96	G3-12	1	1
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Engineering Study for the Phase I Privatization Facilities Electrical Power

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ENGINEERING STUDY FOR THE PHASE I PRIVATIZATION FACILITIES ELECTRICAL POWER

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CONTENTS

LIST OF TERMS

AC	Alternating Current
BPA	Bonneville Power Administration
DOE	U.S. Department of Energy
EU	Electrical Utilities Group
HWVP	Hanford Waste Vitrification Plant
Hz	Hertz
ICF KH	ICF Kaiser Hanford Company
kV	Kilovolt
MTBF	Mean time between failure
MW	Megawatt
MYPP	Multi-Year Program Plan
RL	U.S. Department of Energy-Richland Operations Office
SCADA	Supervisory control and data acquisition
TWRS	Tank Waste Remediation System
WHC	Westinghouse Hanford Company
WNP	Washington Public Power Supply System Nuclear Plant

ENGINEERING STUDY FOR THE PHASE I PRIVATIZATION FACILITIES ELECTRICAL POWER

1.0 OBJECTIVE

1.1 BACKGROUND

The U.S. Department of Energy (DOE) has committed to deliver up to 20 Megawatt (MW) electrical power at 13.8 kilovolt (kV), 60 Hertz (Hz), three-phase alternating current (AC) for Phase I privatization facilities at each contractor's site perimeter (DOE 1996 and WHC 1996). Two Phase I privatization contractors are anticipated at this time. These privatization contractors' facilities will be located on the east side of the 200 East Area (WHC 1995).

Electrical power to the 200 Area facilities is currently provided by nine 13.8-kV distribution lines. The distribution lines originate from the 251-W substation, located approximately 4.8 to 6.4 km (3 to 4 mi) north of the 200 Areas, then distribute electrical power throughout the 200 East, West, and 600 North Areas. The average load at this substation is currently 23 MW. However, forecasted load growth will increase the average load to 32.8 MW by 2003 (Uecker 1996). The existing practice of the ICF Kaiser Hanford Company (ICF KH) Electrical Utilities (EU) group is to operate the 251-W substation at an availability of 100 percent. This means that no outages are planned for the 251-W substation that will require any 200 Area facility to curtail its operations. To accommodate this existing operating practice, the maximum available power at the 251-W substation is limited to 47.5 MW (assuming a lagging power factor of 0.95). This means that there will be only 14.7 MW available for the privatization facilities in 2003 (47.5 MW - 32.8 MW = 14.7 MW). The 251-W substation can provide more than 47.5 MW; however, operating above this value will likely require curtailed operations of the privatization contractor facilities during times of EU group maintenance within the 251-W substation. Curtailed operations of the privatization facilities is assumed to be unacceptable. Therefore, a source of power other than the 251-W substation will be needed to provide the required electrical service to the privatization contractors.

Previous informal studies performed for the Hanford Waste Vitrification Plant (HWVP) indicated a need for a new 230-kV substation. These studies included various options for furnishing power to HWVP from the existing 251-W Substation (Smith 1989 and Larson 1989). Based on these studies, the HWVP 230-kV substation, Project B595, was designed. The electrical service requirements between the HWVP and the privatization facilities are similar. Since the studies for the HWVP project were not formally documented in a supporting document, this engineering study is needed to document the basis for selecting the new power supply for the privatization facilities.

After consultation with the Bonneville Power Administration (BPA), this engineering study limited its evaluation to two different electrical transmission systems to provide power to a new substation. The new substation would transform the transmission system voltage to the necessary 13.8-kV distribution system that would deliver the required 40 MW to the privatization facilities. The two electrical transmission system evaluated are: (1) the RL 230-kV transmission system, and (2) the BPA 115-kV transmission system. These two transmission systems were selected because of their close geographical location to the proposed privatization contractor site.

1.2 PURPOSE AND NEED

A preliminary estimate (Reynolds 1996) indicates that the TWRS Phase I privatization facilities will require approximately 40 MW (two facilities at 20 MW each) of electrical power. This study considers three possible alternatives that may be able to provide 13.8-kV electrical service to the Phase I privatization contractors: (1) using existing 200 Area 251-W Substation, 13.8-kV distribution system (2) using the BPA 115-kV transmission system to provide power to a new 115-13.8 kV substation, and (3) using the RL 230-kV transmission system to provide power to a new 230-13.8 kV substation. This engineering study evaluates these alternatives and recommends a preferred alternative that best meets the requirements of the privatization facilities.

2.0 SUMMARY

The DOE has committed to deliver up to 20 MW electrical power at 13.8 kV for each of the two privatization facilities at each contractor's site perimeter (DOE 1996). This engineering study evaluates three alternatives and recommends a preferred alternative that best meets the requirements of the privatization facilities. The preferred alternative, Alternative 3, will provide 20 MW of power to each privatization facility by a new 230-13.8 kV substation and associated distribution system. This new substation will be located near the privatization facilities and will receive power from the A4-8, RL 230-kV transmission line, which is approximately two miles from the privatization facilities.

The selection of the preferred alternative is accomplished by comparing each alternative against the other. To accomplish this comparison, a selection process was created to measure the degree to which each alternative satisfied certain decision criteria. The selection process was derived from a discussion by personnel involved in the study. The selection process included the performance of each alternative to certain criteria, i.e., power delivery capability, voltage regulation, availability, reliability, costs, safety and operability.

The preliminary cost estimate for the preferred alternative (Alternative 3) is approximately $11.5 million. The details of this estimate are included in Appendix D. The estimate includes costs for engineering, project management, site work, 230-kV switchgear and transmission line, 13.8-kV switchgear, and control/switchgear buildings. The cost for the distribution of 13.8-kV power from the substation to the privatization facilities site boundary is not included in this estimate. This cost will be established during the conceptual design. A life-cycle cost analysis was not considered because the life-cycle cost for such upgrades/modifications is proportional to the initial cost. The number of major components will be almost the same for the 115-13.8 kV and 230-13.8 kV substations with the exception of the primary voltages. Hence, the life-cycle cost for operation, maintenance, testing, energy usage of both substations will not differ significantly.

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3.0 RECOMMENDATION AND CONCLUSIONS

3.1 RECOMMENDATIONS

This study recommends that DOE will build a new 230-13.8 kV substation with the associated 13.8-kV distribution system and extend the RL 230-kV transmission system approximately 3.2 km (2 mi) into the 200 Area to provide power to the new substation. The transmission system shall be compatible with the existing RL 230-kV transmission line capacity and reliability. The substation and distribution system to be built will provide the needed electrical service to the privatization facilities. The substation design shall provide capabilities for further expansion to accommodate power needs of future facilities.

3.2 CONCLUSIONS

Alternative 3 is the preferred alternative. Using the RL 230-kV transmission system to provide power to a new 230-13.8 kV substation is less costly, more reliable, more maintainable, more operable, and will have less impact to the environment than the other alternatives. Alternative 1 was screened out because of the inability of the 251-W substation to provide the privatization facility's load without a severe impact to the 200 Area electrical utility system availability. Although Alternative 2 can provide the required privatization facility load, the characteristics and costs of Alternative 2 are less desirable than Alternative 3.

This study concludes that the existing 251-W substation cannot adequately supply 40 MW to the privatization facility due to poor voltage regulation (excessive voltage drop conditions) or unsatisfactory degradation to system availability. However, it is noted that construction power, of up to 5 MW, can be provided to the privatization facilities, by the 251-W substation with adequate voltage regulation by extending existing 13.8-kV distribution lines C8L5 and C8L8.

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4.0 UNCERTAINTIES

The following uncertainties may affect the recommendation of this study:

1. The process and the type of melter to be used by the privatization contractor are unknown at this time. Therefore, a definitive electrical load profile for the privatization facilities will not be known until the electrical data are received from the privatization contractor. Although definitive load data will be provided by the privatization contractor(s) after the contract award, it is anticipated that the TWRS Phase I privatization facilities will require 40 MW by 2003.

2. It is not clear if the BPA will be able to obtain funding to install a 100-MVAR capacitor bank at the BPA Ashe substation. A firm commitment from RL to buy the forecasted power is needed for the BPA to justify installation of the capacitor bank. If the BPA does not install the capacitor bank, then 13.8-kV voltage regulation equipment may be required at the new 230-kV substation to ensure voltage service requirements are satisfied.

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5.0 DESCRIPTION OF ALTERNATIVES AND SOLUTIONS

5.1 CRITERIA

5.1.1 Selection Criteria

A criterion is a factor that is used to select a preferred alternative. Selection criteria are required to further evaluate viable alternatives. Various alternatives for providing electrical power are described in Section 5.3. This section is devoted to the development of the criteria that provide the mechanism for evaluation of the alternatives.

Thirteen points of criteria were determined that best provide a basis for alternative comparison. They are as follows: (1) Safety, (2) Power Delivery, (3) Voltage Regulation, (4) Reliability, (5) Availability, (6) Operability, (7) Environmental Impact Considerations, (8) Maintainability, (9) Costs, (10) Schedule, (11) Program Integration, (12) Expansion Capabilities, and (13) Other Factors.

1. **Safety** was defined as mission and property protection. This also includes a comparison of associated hazards during construction, maintenance, and operation.

2. **Power Delivery** considered the ability to serve the required electrical load. The current requirement is that the alternative must be able to provide 20 MW to each privatization contractor for a total of 40 MW. This study assumed no diversity between the two privatization contractor loads; therefore, 40 MW was used as the total required load.

3. **Voltage Regulation** considered the ability to serve the privatization facilities above the minimum voltage service requirement of 13.46 kV (ANSI C84.1).

4. **Reliability** considered the mean time between failure (MTBF), consequences of failure and recovery time, and preventive maintenance impact. The type and extent of new electric systems for industrial plants must carefully balance the costs of anticipated interruptions to electrical service against the capital costs of the systems involved. Each instance requires a separate analysis taking into account special production and occupancy needs. Because of the many variables involved and the uncertainty of the privatization facilities processes, this study did not attempt to obtain the cost of electrical interruptions for the privatization facilities. Two reliability indexes were used to evaluate each alternative: (1) load interruption frequency and (2) duration of load interruptions events.

5. **Availability** considered the ability to satisfactorily perform its intended function at all times. Curtailed operations at the privatization facilities are not acceptable. Availability does not include the frequency and duration of unplanned outages (see Reliability).

6. **Operability** considered ease of use/complexity, manual/automatic features, work force, start-up/shut-down, and troubleshooting/response to abnormal conditions.

7. **Environmental Impact Considerations** considered the permitting requirements.

8. **Maintainability** considered prevention/correction, repair ability (mean time to repair), and functional test requirements.

9. **Costs** included capital costs, development costs, and life-cycle costs.

10. **Schedule** was defined as design, installation, start-up time, and impact on a system or *Hanford Federal Facility Agreement and Consent Order* (Tri-Party Agreement) (Ecology et al. 1994).

11. **Program Integration** considered a variety of interfaces within a specific project as well as interfaces among other projects included in the TWRS Multi-Year Program Plan (MYPP). The MYPP includes plans and strategies that accomplish the TWRS mission within overall scope, cost, and schedule constraints.

12. **Expansion Capabilities** considered the ability to accommodate additional load growth due to future facilities. Load growth is anticipated, but the needs are not clearly defined at this time.

13. **Other Factors** considered compatibility with existing equipment and infrastructure.

5.1.2 Weighing of Selection Criteria

The selection criteria were weighted according to their degree of importance in determining the effectiveness of the alternatives and were assigned numerical values. The performance of each alternative was estimated with respect to each criterion in the subsequent state of the selection process in this report. The performance level was judged as below average, average, or above average with a corresponding score of 1, 2, or 3 respectively. The weighted score is the product of each weighted criterion and the corresponding performance level score. The total score of each alternative is the summation of these products. The specific criterion weight for each selected alternative was derived from a discussion among personnel involved in the study. The corresponding weight factors are shown in Section 6.0, Table 1.

5.2 ASSUMPTIONS

The assumptions used in the study are listed below.

Assumption 1. The 251-W substation will have a planned availability of 100 percent. No facility will have to be placed in a curtailed operation during maintenance activities of the substation which would remove one of the two main transformers from service. Therefore, the total available power from the 251-W Substation is 47.5 MW based on a lagging power factor of 0.95.

Assumption 2. The latest 20-year forecast will be the basis for all non-TWRS Phase I privatization facility load growth for 2003 (Debban 1995). The past two-year historical load data will be used as the base load (Uecker 1996). This will result in a total non-privatization facilities load of 32.8 MW.

Assumption 3. BPA and RL power agreements will remain in place. The service voltage range is +/- 10 percent of nominal voltage. Minimal service voltage is 103.5 kV for the 115-kV system and 207 kV for the 230-kV system (Brown 1996a). However, the minimum voltage BPA uses for planning is 218.5 kV (95 percent of 230 kV) except main grid (Brown 1996b).

Assumption 4. The power supply to existing and planned 200 Area non-TWRS Phase I privatization facilities will be provided by the 251-W Substation. This substation will be maintained to support existing facilities, characterization, and retrieval operations.

Assumption 5. The new electrical system voltages will be compatible with existing ICF KH EU group system voltage levels. This will minimize spares, additional test/maintenance tools and instruments, procedures, and training.

Assumption 6. Minimum service voltage at the privatization facility's 13.8-kV service point shall meet the voltage regulation criteria stated in Section 5.1.1.

Assumption 7. This study will be revised when specific privatization facility power needs are available from the contractor. The alternatives provided by BPA are preliminary at this time and will be reviewed and approved when DOE commitments to buy projected power are confirmed.

Assumption 8. The power supply to the privatization facilities should be served by dedicated circuits. Each privatization facility will have a normal and a backup feeder that will not share loads with any other facility.

Assumption 9. The line routings, layout, and location of the substation will be determined after the contract award upon availability of the specific power needs from the privatization facility contractor(s).

Assumption 10. The load was considered to be 20 MW per privatization facility and did not include any diversity.

5.3 ALTERNATIVES

5.3.1 Alternative 1--200 Area 13.8-kV Distribution System

Four 13.8-kV express feeders, originating from the 251-W substation, would be used to provide power to the privatization facilities. Sketches 1 and 2 (see Appendix A) illustrate the proposed routing for this alternative. Load flow studies were performed to evaluate the performance of this alternative. Two cases were studied under this alternative, each involving four express feeders. The first case evaluated two existing express feeders that would be slightly modified and two new lines to provide power to the privatization facilities. The second case evaluated four new express feeders that would provide power to the privatization facilities.

5.3.1.1 Safety. The 251-W substation equipment is maintained to operate safely. No safety problems are identified at this time.

5.3.1.2 Power Delivery. The 251-W substation has the capability to provide 95 MW, based on a lagging power factor of 0.95. The forecasted load at the 251-W Substation for 2003 is 32.8 MW. There will be 62.2 MW of power available for the privatization facilities. The load flow studies that were performed (see Appendix B) indicate that four new express feeders can be constructed that can provide the required 40 MW. However, a curtailed operation (Assumption 1) of facilities is not permitted; therefore, the power delivery is limited to 47.5 MW.

5.3.1.3 Voltage Regulation. The first case evaluated under this alternative resulted in poor voltage regulation at a load greater than 5 MVA per express feeder. At values above the 5 MVA per express feeder (above 20 MVA total), the service voltage at the privatization contractors will be below the required minimum specified in Assumption 6. The second case evaluated under this alternative resulted in no voltage regulations problems for a load of 10 MVA per express feeder.

5.3.1.4 Availability. The 251-W substation has two transformers, each capable of supplying the entire existing substation load. Based on Assumptions 1 and 2, there will be 14.7 MW available for the privatization contractors in 2003. This value is below the required 40 MW needed by the privatization contractors.

5.3.1.5 Screening of Alternative 1. Based on the load flow studies in Appendix B and the assumptions listed in Section 5.2, none of the cases evaluated in this alternative are acceptable. The cases evaluated for Alternative 1 did not satisfy either the power delivery requirements, due to the limitations of the 251-W substation transformers, or the voltage regulation requirements. This alternative is not viable, because it does not meet these two criteria. No further discussion was included on the other evaluation criteria. This alternative was dropped from further consideration.

5.3.2 Alternative 2--BPA 115-kV Transmission System

This alternative includes the construction of a new 115-kV substation and approximately 22.5 km (14 mi) of 115-kV transmission line. The new 115-kV substation would be located in the 200 Area, close to the privatization facilities. A new 115-kV transmission line, approximately 4.8 km (3 mi) in length, would be extended from the Midway-Benton loop at Eagle Point to the new substation. A second new 115-kV transmission line, approximately 17.7 km (11 mi) in length, would be extended from the 451-B Substation, located in the 400 Area, to the new substation. Modifications at the 451-B Substation would be necessary to extend a new 115-kV transmission line from the 451-B Substation to the new substation. The diagram in Appendix C, page C-9, illustrates the proposed routing for this alternative. Several loading scenarios were evaluated by the BPA under this alternative and are provided in Appendix C.

5.3.2.1 Safety. Other than the safety requirements in the industry standards and codes, no other special safety features are needed.

5.3.2.2 Power Delivery. The load flow studies performed by the BPA (see Appendix C) indicate that the BPA 115-kV system can adequately deliver up to 60 MW of load for the privatization facilities.

5.3.2.3 Voltage Regulation. The load flow studies indicate that the lowest expected voltage at the new 115-kV substation would be 118 kV. This is well within the acceptable limits as listed in Assumption 3.

5.3.2.4 Reliability. Based on the historical data for outage frequency and durations over the past five years, the BPA states in Appendix C that the 115-kV system is ten times less reliable than the 230-kV system.

5.3.2.5 Availability. The new substation and distribution system can be designed so that electrical service to the privatization facilities will be satisfactorily performing its intended function at all times.

5.3.2.6 Operability. This alternative involves additional modification at the 451-B Substation which does not have a supervisory control and data acquisition (SCADA) system interface with the electrical utility dispatching center, located at 251-W Substation.

5.3.2.7 Environmental Impact Considerations. The BPA study states that the environmental impact considerations will be greater with the 115-kV transmission system. Alternative 2 involves about 22.5 km (14 mi) of new 115-kV transmission lines. Eighteen kilometers of the new transmission line would travel from the 400 Area to the 200 East Area and would require an environmental assessment and possibly an environmental impact statement at an estimated cost greater than $100,000 and at a duration of up to 2 years.

5.3.2.8 Maintainability. This alternative involves additional maintenance activities as a result of the additional modifications at the 451-B Substation. More equipment will require maintenance under this alternative than under Alternative 3.

5.3.2.9 Costs. The BPA provided rough order-of-magnitude estimates (see Appendix C) for the design and construction of the transmission lines, substation, and modifications to the 451-B Substation. The estimates did not include costs for 115-kV station bypass equipment, the 13.8-kV control house and equipment, and communication equipment as well as other utility equipment (water, sewer, telecommunications, etc). The rough order-of-magnitude estimate provided by the BPA is as follows:

115-kV transmission lines	$3.50 million
115-kV substation	$3.15 million
Modifications at the 451-B Substation (construction of new bay with two 115-kV breakers)	$2.00 million
Total costs	$8.65 million

5.3.2.10 Schedule. Based on discussions with BPA, there is no discrimination between the schedule times for Alternatives 2 and 3. The design, installation, and start-up time can be accomplished by 2003.

5.3.2.11 Program Integration. This alternative has the ability to supply up to 60 MW for TWRS and other project needs.

5.3.2.12 Expansion Capabilities. The new substation and distribution system can be designed so that electrical service to the privatization facilities will be satisfactorily performing its intended function at all times.

5.3.2.13 Other Factors. This alternative would introduce a new infrastructure voltage classification into the 200 Area.

5.3.3 Alternative 3--RL 230-kV Transmission System

This alternative includes the construction of a new 230-kV substation and approximately 6.4 km (4 mi) of 230-kV transmission line. The new 230-kV substation would be located in the 200 Area, close to the privatization facilities. The new 230-kV transmission lines would be tapped into the existing RL 230-kV transmission system. The diagram in Appendix C, page C-10, and Sketch 5 (see Appendix A) illustrate the proposed routing for this alternative. Also, a preconceptual one-line diagram is shown on Sketch 6 (see Appendix A). Several loading scenarios were evaluated by the BPA under this alternative. Two cases were evaluated under this alternative; each are provided in Appendix C. The second case modeled a 100-MVAR capacitor bank at the BPA Ashe Substation. The BPA may require that a capacitor bank be installed, at BPA expense, to ensure a BPA contractual voltage regulation requirement is kept with the Washington Public Power Supply System Nuclear Plant (WNP) #2. BPA is required to maintain a voltage of 234.4 kV at the WNP #2. Due to the electrical service requirements of the privatization facilities, BPA may be required to install the capacitor bank to maintain the voltage at the WNP #2 to 234.4 kV or greater.

5.3.3.1 Safety. Other than the safety requirements in the industry standards and codes, no other special safety features are needed.

5.3.3.2 Power Delivery. The load flow studies performed by the BPA (see Appendix C) indicate that the RL 230-kV system can adequately deliver up to 60 MW of load for the privatization facilities.

5.3.3.3 Voltage Regulation. The load flow studies in Appendix C indicate that the lowest expected voltage at the new 230-kV substation would be 212 kV, when evaluated without the 100 MVAR capacitor bank and 232 kV with the capacitor bank. The minimum service voltage of 212 kV does not meet 218.5 kV minimum voltage criterion for BPA planning. The BPA preliminary studies conducted following the study in Appendix C, indicate that the base case used does not represent the worst case conditions for the Ashe 230-kV voltage limit and worst violation could occur during the outages with low generation level at the Mid Columbia (Berhanu 1996). In addition, these preliminary studies show a need to install an approximately 90-MVAR capacitor bank at Ashe 230-kV bus to maintain adequate voltage (234.4 kV or higher at WNP-2) when needed (Brown 1996b). It is not certain that BPA will install this capacitor bank. Addition of TWRS load will need an additional 30 MVAR capacitor bank. To resolve the voltage regulation problem at TWRS new 230-kV substation, a voltage regulator on the low voltage side of the transformer is highly recommended by the BPA.

5.3.3.4 Reliability. Based on the historical data for outage frequency and durations over the past five years, the BPA states in Appendix C that the 230-kV system is ten times more reliable than the 115-kV system.

5.3.3.5 Availability. The new substation and distribution system can be designed so that electrical service to the privatization facilities will be satisfactorily performing its intended function at all times.

5.3.3.6 Operability. This alternative can interface with the supervisory control and data acquisition (SCADA) system interface with the electrical utility dispatching center, located at 251-W Substation.

5.3.3.7 Environmental Impact Considerations. Alternative 3 involves about 6.4 km (4 mi) of new 230-kV transmission line traveling approximately 3.2 km (2 mi) from North of the 200 East Area to the 200 East Area. An environmental assessment for categorical exclusion per *National Environmental Policy Act of 1969* (NEPA) will be needed to ensure that a similar project has been allowed in previous environmental studies for 200 Area. Assessments of this kind normally take one to three months and may cost approximately $3,000.

5.3.3.8 Maintainability. This alternative involves the less maintenance than Alternative 2. Alternative 2 has additional maintenance due to the additional modifications at the 451-B Substation.

5.3.3.9 Costs. The BPA provided rough order-of-magnitude estimates (see Appendix C) design and construction of the transmission lines and substation. The estimates did not include costs for 230-kV station bypass equipment, the 13.8-kV control house and equipment, and communication equipment as well as other utility equipment (water, sewer, telecommunications, etc.). The rough order-of-magnitude estimate provided by the BPA is as follows:

230-kV transmission lines	$1.66 million
230-kV substation	$5.20 million
Total costs	$6.86 million

In addition to this cost a voltage regulator costing roughly $100,000 is also recommended. Therefore, the total estimated cost for this option is considered $6.96 million.

5.3.3.10 Schedule. Based on discussions with the BPA, there is no discrimination between the schedule times for Alternatives 2 and 3. The design, installation, and start-up time can be accomplished by 2003.

5.3.3.11 Program Integration. This alternative has the ability to supply up to 60 MW for TWRS and other project needs.

5.3.3.12 Expansion Capabilities. The new substation and distribution system can be designed so that electrical service to the privatization facilities will be satisfactorily performing its intended function at all times.

5.3.3.13 Other Factors. This alternative would not introduce a new infrastructure voltage classification into the 200 Area.

5.3.4 Alternative 4--No Action Alternative

The privatization contractors will require additional power. Therefore, the no action alternative is not viable and was screened from evaluation.

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6.0 DISCUSSION OF PREFERRED ALTERNATIVE/SOLUTION

Alternatives 2 and 3 were compared against the decision criteria based on a discussion amongst involved personnel for the study. The results of the comparison are listed below and are summarized in Table 1. The preferred alternative is Alternative 3. Alternatives 1 and 4 were not analyzed because they were screened out in earlier sections.

1. **Safety**. There is no discrimination between the two alternatives. Therefore, each alternative is assigned a score of 2.

2. **Power Delivery**. There is no /discrimination between the two alternatives. Therefore, each alternative is assigned a score of 2.

3. **Voltage Regulation**. There is a slight advantage with Alternative 3 because of the BPA requirement to maintain voltage levels at the WNP #2 facility. This will provide an artificial voltage regulator. Therefore, Alternatives 2 and 3 are assigned a score of 2 and 3, respectively.

4. **Reliability**. According to the BPA, Alternative 3 will be ten times as reliable. Therefore, Alternatives 2 and 3 are assigned a score of 1 and 3, respectively.

5. **Availability**. There is no discrimination between the two alternatives. Therefore, each alternative is assigned a score of 2.

6. **Operability**. The 451-B Substation does not have a SCADA interface with the 251-W Substation dispatcher. Therefore, Alternatives 2 and 3 are assigned a score of 1 and 3, respectively.

7. **Environmental Impact Considerations**. Alternative 2 will require an environmental impact statement and other permitting due to the length of the line, whereas, Alternative 3 will not require any substantial permitting. Therefore, Alternatives 2 and 3 are assigned a score of 1 and 3, respectively.

8. **Maintainability**. Due to the additional modifications that will be needed at the 451-B Substation in Alternative 2, there will be more maintenance required. Therefore, Alternatives 2 and 3 are assigned a score of 2 and 3, respectively.

9. **Costs**. Alternative 3 cost is less than Alternative 2. Therefore, Alternatives 2 and 3 are assigned a score of 2 and 3, respectively.

Table 1. Evaluation Criteria Results.

Evaluation criteria	Weight	Alternative 2		Alternative 3	
		Performance score	Weighted score	Performance score	Weighted score
Safety	0.14	2	0.28	2	0.28
Power delivery	0.12	2	0.24	2	0.24
Voltage regulation	0.11	2	0.22	3	0.33
Reliability	0.10	1	0.10	3	0.30
Availability	0.09	2	0.18	2	0.18
Operability	0.09	1	0.09	3	0.27
Environmental impact considerations	0.08	1	0.08	3	0.24
Maintainability	0.07	2	0.14	3	0.21
Costs	0.06	2	0.12	3	0.18
Schedule	0.05	2	0.10	2	0.10
Program integration	0.04	2	0.08	2	0.08
Expansion capabilities	0.03	2	0.06	2	0.06
Other factors	0.02	1	0.02	3	0.06
Total	1.00	Score	1.71	Score	2.53

Scoring
1 - Below average
2 - Average
3 - Above average.

10. **Schedule**. There is no discrimination between the two alternatives. Therefore, each alternative is assigned a score of 2.

11. **Program Integration**. There is no discrimination between the two alternatives. Therefore, each alternative is assigned a score of 2.

12. **Expansion Capabilities**. There is no discrimination between the two alternatives. Therefore, each alternative is assigned a score of 2.

13. **Other Factors**. The 115-kV infrastructure will be new to the 200 Area, whereas, 230 kV already exists. Therefore, Alternatives 2 and 3 are assigned a score of 1 and 3, respectively.

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APPENDIX A

SKETCHES

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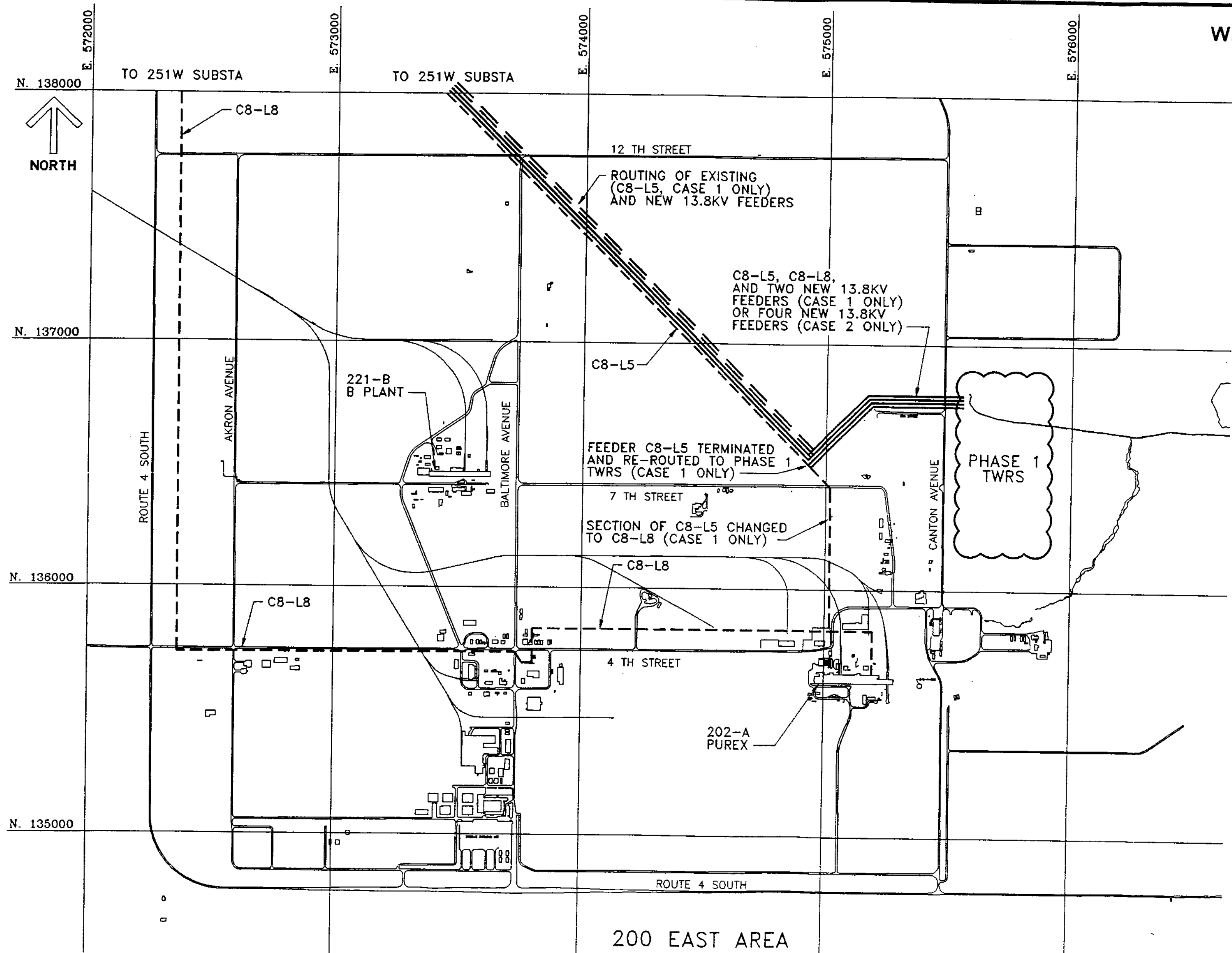
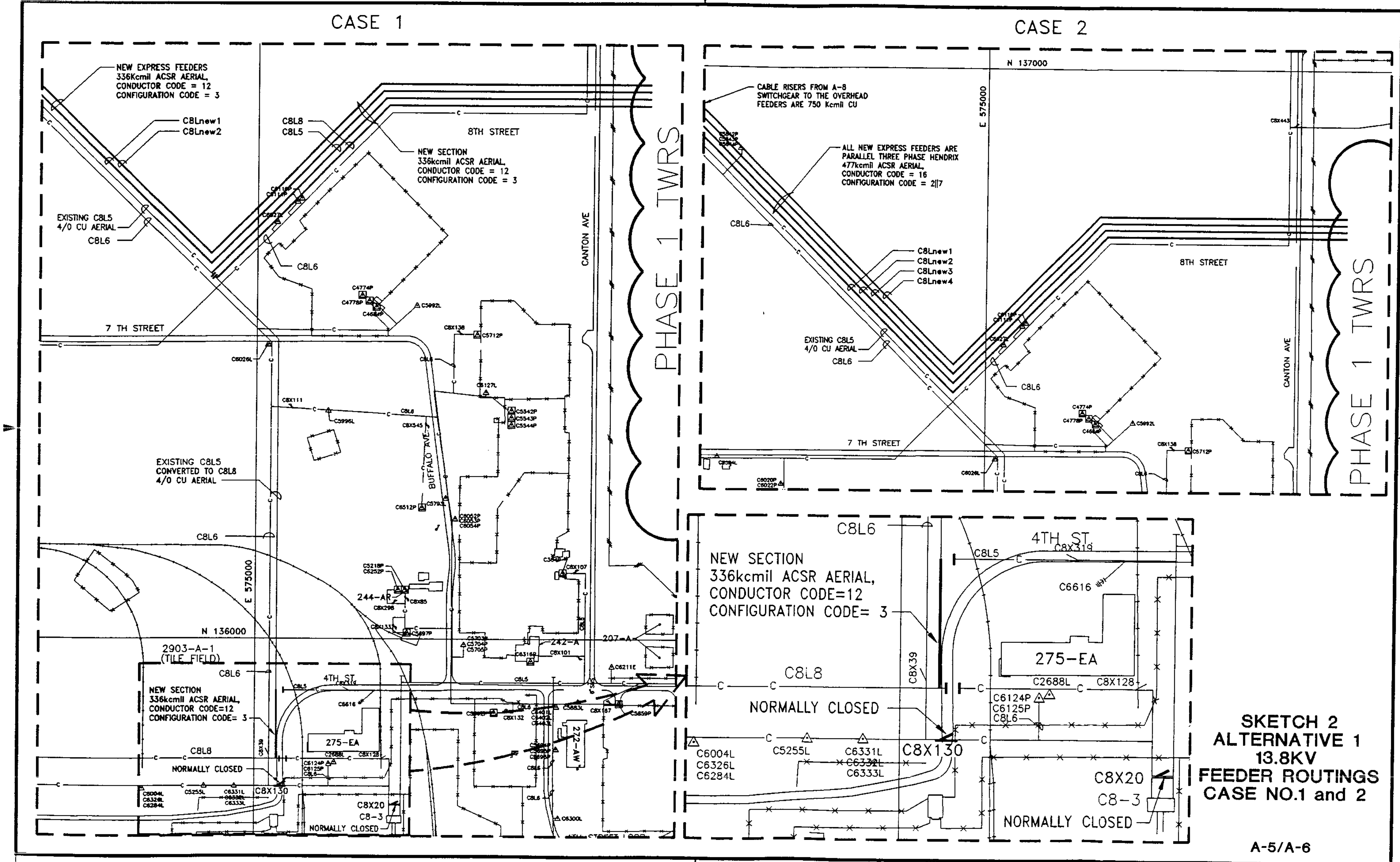
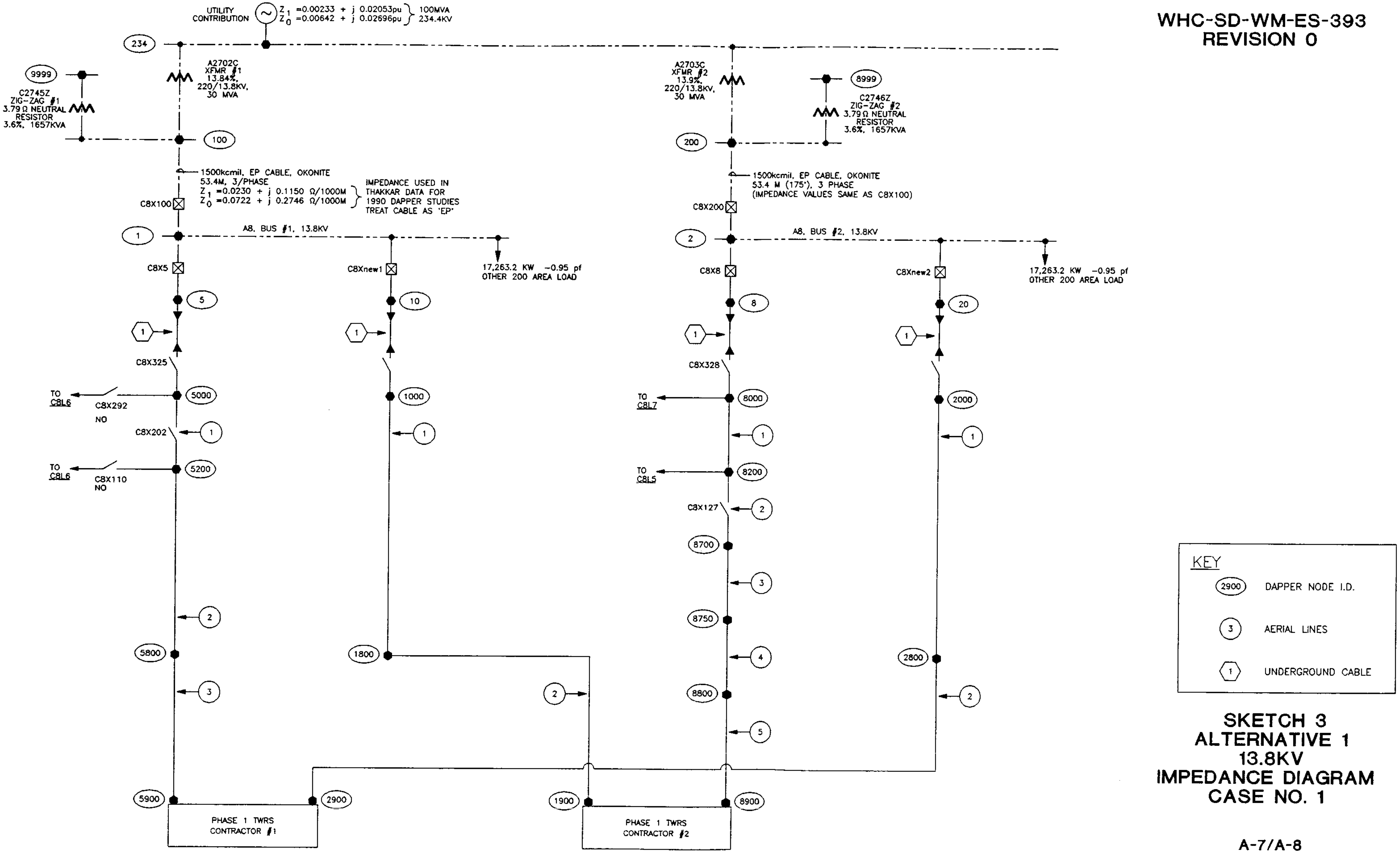


SKETCH 1
ALTERNATIVE 1
13.8KV
FEEDER ROUTINGS
LOCATOR MAP

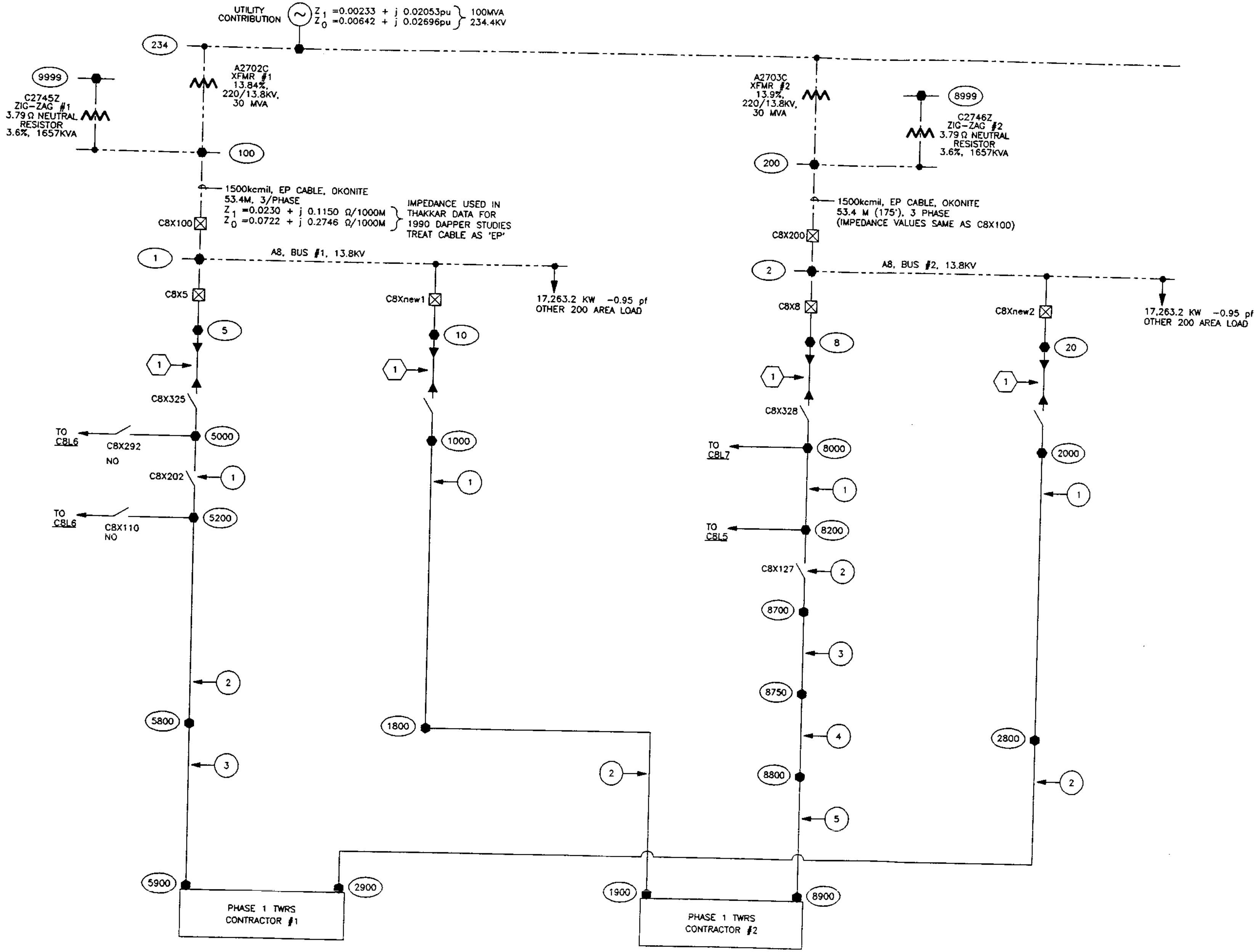


SKETCH 2
ALTERNATIVE 1
13.8KV
FEEDER ROUTINGS
CASE NO.1 and 2

A-5/A-6



SKETCH 3
ALTERNATIVE 1
13.8KV
IMPEDANCE DIAGRAM
CASE NO. 1



KEY

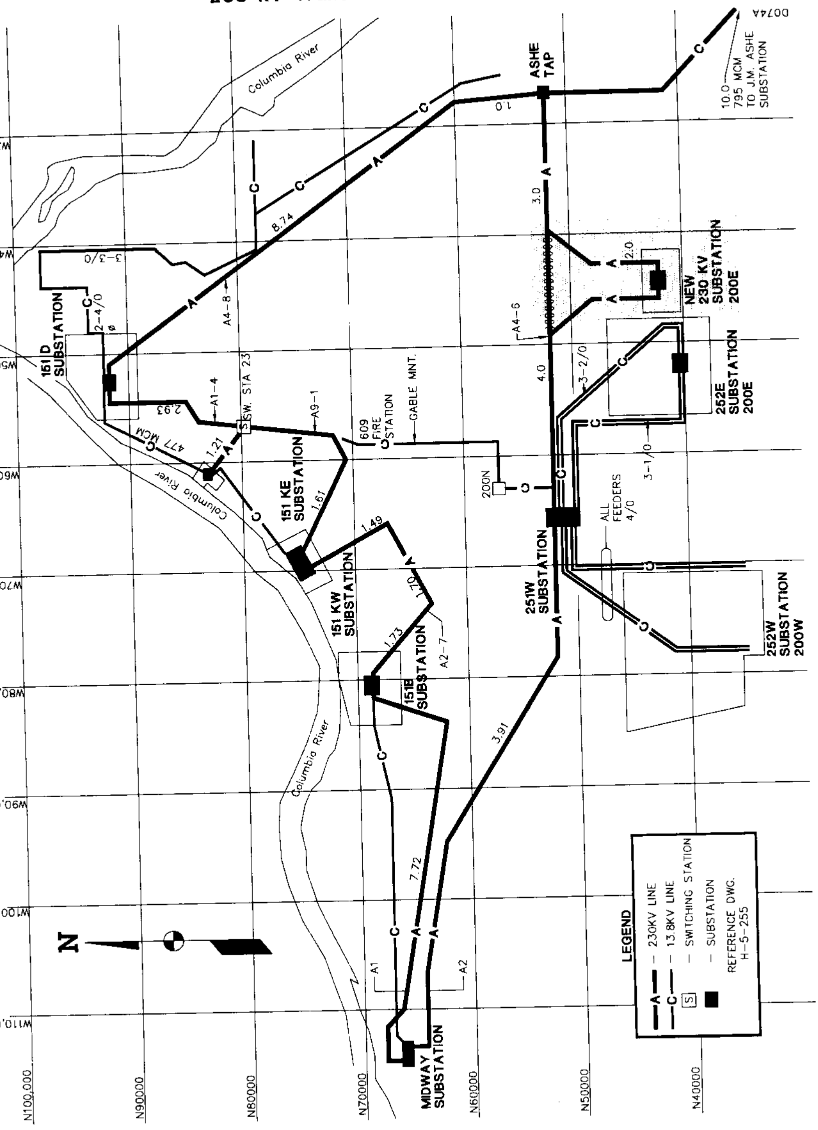
2900 DAPPER NODE I.D.

3 AERIAL LINES

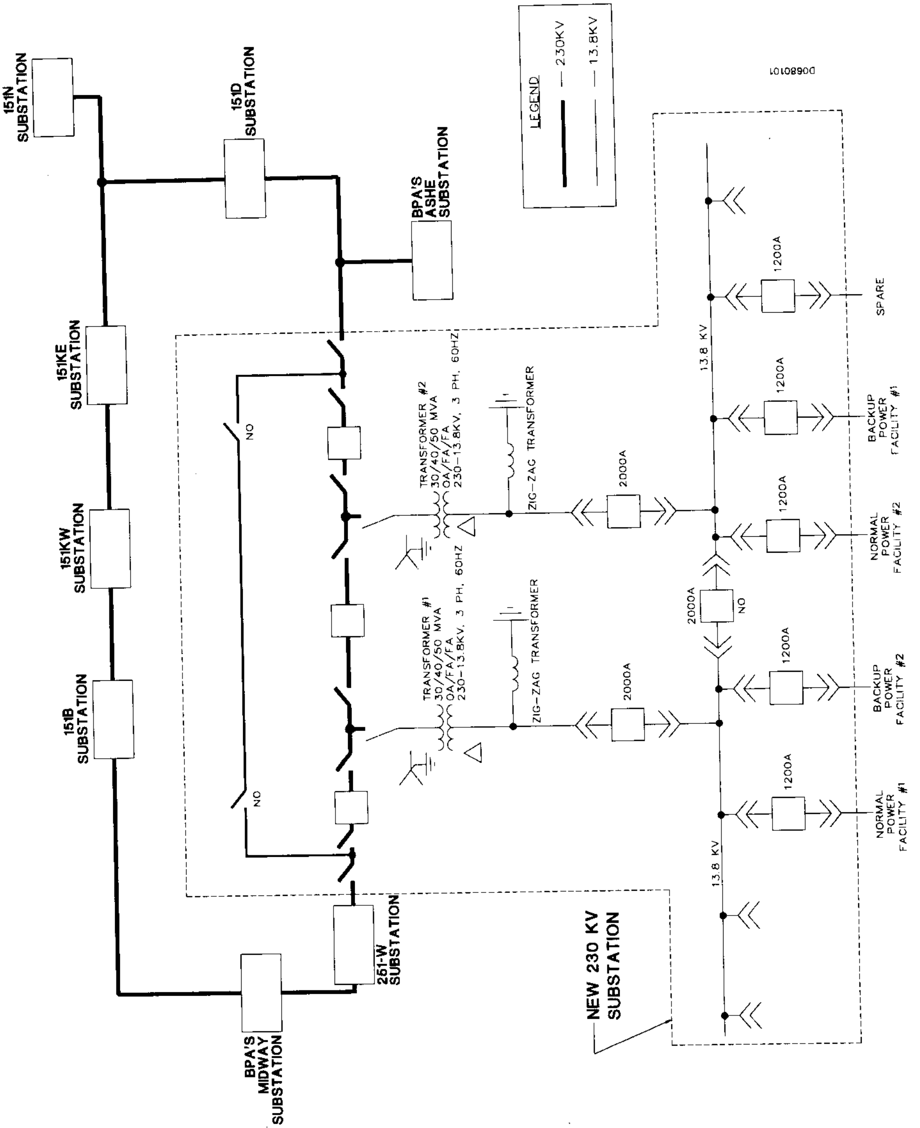
1 UNDERGROUND CABLE

SKETCH 4
ALTERNATIVE 1
13.8KV
IMPEDANCE DIAGRAM
CASE NO. 2

Sketch 5--Alternative 3, 230 kV Transmission System Map



Sketch 6--Alternative 3,
230 kV Oneline Diagram



APPENDIX B

ALTERNATIVE 1
ICF KH LOAD FLOW
CALCULATIONS

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APPENDIX B

ALTERNATIVE 1
ICF KH LOAD FLOW
CALCULATIONS

B1.0 ALTERNATIVE 1 DESCRIPTION

Four 13.8-kV express feeders, originating from the 251-W Substation, would be used to provide power to the privatization facilities. The study evaluated two cases under this alternative. The cases are illustrated in Appendix A, Sketch 1.

B1.1 ALTERNATIVE 1, CASE 1

Case 1 utilized two existing feeders and two new dedicated (express) feeders. Sketch 2, Appendix A, illustrates the routing the express feeders to the privatization site boundary. As illustrated on the sketch, the existing two feeders, C8L5 and C8L8, would be slightly modified to provide express feeder service. The two new express feeders, C8LNEW1 and C8LNEW2, would follow the C8L5 utility corridor. Loading profiles of 5, 6, 7.5, and 10 MVA (at lagging power factor of 0.95), for each privatized facility, equally distributed on each feeder, were evaluated in this case.

B1.2 ALTERNATIVE 1, CASE 2

Case 2 utilized four new express feeders. The four new express feeders would follow the C8L5 utility corridor as shown on Sketch 2, Appendix A. A loading profile of 20 MW (at lagging power factor of 0.95), for each privatized facility, equally distributed on each feeder, was evaluated.

B2.0 SYSTEM MODELING AND LOAD FLOW CALCULATIONS

Impedance diagrams were developed for each alternative and are represented on Sketches 3 and 4, Appendix A, for Cases 1 and 2, respectively. Based on the impedance diagrams, load flow calculations were performed using DAPPER computer program, version 4.5, SKM Systems Analysis Inc. The following assumptions were used in each case.

- No change in the existing operating practices for the 200 Area distribution system. The existing operating practice is that no facility will have to be placed in a curtailed operation during maintenance activities at the 251-W substation which would remove one of the two main substation transformers from service.

- Existing 200 Area forecasted loads shall be used to ensure other programs and facilities are not impacted by the additional load brought on by the Privatized Facilities. The 251-W substation was modeled with 17.3 MVA at lagging power factor of 0.95 on each 251-W substation bus. This is the forecasted load for all non-TWRS Phase I privatized facilities for 2003.

- The study shall use no diversity when modeling the load at the 251-W Substation and at the privatized facilities service point.

- The loads at each privatized facility shall be estimated at 10, 12, 15, and 20 MVA, at a lagging power factor of 0.95 power.

- The 200 Area 13.8-kV distribution line C8L5 and a new distribution line will be used as a source of power for the one privatized facility. Distribution line C8L8 and a new distribution line will be used as a source of power for the second privatized facility. For reliability reasons, one express feeder from each 251-W Substation bus was modeled to provide power to each privatization facility. This results in two express feeders to each privatization facility.

- The 230-kV system voltage was modeled at 234.4 kV. 234.4 kV is the regulatory requirement BPA must meet at the WNP #2 start-up transformers, located near the Ashe Substation.

- The 251-W substation primary transformers were modeled at 220-kV primary volts with a tap of -5 percent.

B3.0 MODELING DATA

Sketches 3 and 4, Appendix A, depict the impedance diagrams used for each case. The source and assumptions for each of the impedances are listed below.

B3.1 IMPEDANCE DATA

Impedance data are listed in Table B-1 and were developed from existing distribution maps drawings. Based on the data listed in Table B-1, positive and zero sequence impedances were then calculated by ICF KH using approved ICF KH practices (WHC 1993). The resulting sequence impedances are listed in Table B-2.

B3.2 UTILITY CONTRIBUTION AND TRANSFORMER DATA

Utility contribution data were calculated to be 1.27815 + j11.2773 ohms (positive sequence) and 3.52547 + j14.8118 ohms (zero sequence) (Akerson 1996). Transformer data were obtained from electrical utility test sheets and impedance diagram H-6-13436.

B3.3 LOAD DATA

As noted in the above assumptions, the non-privatization facility loads were modeled at 34.6 MVA, 17.3 MVA for each 251-W substation bus. The power factor for this load was modeled at a lagging 0.95. These values are based on existing 251-W load base and forecasted growth (Uecker 1996).

Table B-1. Impedance Data.

TWRS CASE 1

Line	Segment	Bus From/To	Length (meters)	Description	Cond. Code	Config. Code
C8L5	1	5 - 5000	46	500 kcmil cable	9	9
	1	5000 - 5200	4730.5	4/0 Copper aerial	8	1
	2	5200 - 5800	1417.3	4/0 Copper aerial	8	1
	3	5800 - 5900	800.1	336 ACSR aerial	12	3
C8L8	1	8 - 8000	87	500 kcmil cable	9	9
	1	8000 - 8200	6941.8	336 ACSR aerial	12	1
	2	8200 - 8700	1371.6	336 ACSR aerial	12	4
	3	8700 - 8750	91.4	336 ACSR aerial	12	3
	4	8750 - 8800	605.8	4/0 Copper aerial	8	1
	5	8800 - 8900	800.1	336 ACSR aerial	12	3
New 1	1	10 - 1000	87	500 kcmil cable	9	9
	1	1000 - 1800	6147.8	336 ACSR aerial	12	3
	2	1800 - 1900	800.1	336 ACSR aerial	12	3
New 2	1	20 - 2000	87	500 kcmil cable	9	9
	1	2000 - 2800	6147.8	336 ACSR aerial	12	3
	2	2800 - 2900	800.1	336 ACSR aerial	12	3

TWRS CASE 2

Line	Segment	Bus From/To	Length (meters)	Description	Cond. Code	Config. Code
New 1	1	10 - 1000	87	750 kcmil cable	10	9
	1	1000 - 1800	6148	2-477 ACSR aerial	16	2¦¦7
	2	1800 - 1900	800.1	2-477 ACSR aerial	16	2¦¦7
New 2	1	20 - 2000	87	750 kcmil cable	10	9
	1	2000 - 2800	6148	2-477 ACSR aerial	16	2¦¦7
	2	2800 - 2900	800.1	2-477 ACSR aerial	16	2¦¦7
New 3	1	30 - 3000	87	750 kcmil cable	10	9
	1	3000 - 3800	6147.8	2-477 ACSR aerial	16	2¦¦7
	2	3800 - 3900	800.1	2-477 ACSR aerial	16	2¦¦7
New 4	1	40 - 4000	87	750 kcmil cable	10	9
	1	4000 - 4800	6147.8	2-477 ACSR aerial	16	2¦¦7
	2	4800 - 4900	800.1	2-477 ACSR aerial	16	2¦¦7

Table B-2. Sequence Impedance Data (Per Unit).

POSITIVE SEQUENCE IMPEDANCES

Conductor Description	Cond. Code	Config .Code	R1 ohms/mile	X1 ohms/mile	R1 ohms/km	X1 ohms/km	Source
500 kcmil cable	9	9	0.1141	0.1889	0.0709	0.1174	AM-FM Impedance Calculator (WHC-SD-LL-TI-009)
750 kcmil cable	10	9	0.0760	0.1806	0.0472	0.1122	AM-FM Impedance Calculator (WHC-SD-LL-TI-009)
1500 kcmil cable			0.0370	0.1794	0.0230	0.1115	Obtained from old DAPPER Study pre-1990
4/0 Cu aerial	8	1	0.3030	0.6653	0.1883	0.4134	AM-FM Impedance Calculator (WHC-SD-LL-TI-009)
336 ACSR aerial	12	1	0.3220	0.6073	0.2001	0.3774	AM-FM Impedance Calculator (WHC-SD-LL-TI-009)
336 ACSR aerial	12	3	0.3229	0.6409	0.2007	0.3982	AM-FM Impedance Calculator (WHC-SD-LL-TI-009)
336 ACSR aerial	12	4	0.3219	0.6220	0.2000	0.3865	AM-FM Impedance Calculator (WHC-SD-LL-TI-009)
2-477 ACSR aerial	16	2||7	0.1180	0.1634	0.0733	0.1015	L. Holleman calculations of Sept 95
15-kV Bus			0.0370	0.1794	0.0230	0.1115	Same as 1500 kcmil cable

ZERO SEQUENCE IMPEDANCES

Conductor Description	Cond. Code	Config. Code	R0 ohms/mile	X0 ohms/mile	R0 ohms/km	X0 ohms/km	Source
500 kcmil cable	9	9	0.1141	0.1889	0.0709	0.1174	AM-FM Impedance Calculator (WHC-SD-LL-TI-009)
750 kcmil cable	10	9	0.0760	0.1806	0.0472	0.1122	AM-FM Impedance Calculator (WHC-SD-LL-TI-009)
1500 kcmil cable			0.1162	0.4419	0.0722	0.2746	Obtained from old DAPPER Study pre-1990
4/0 Cu aerial	8	1	0.5889	3.5774	0.3659	2.2229	AM-FM Impedance Calculator (WHC-SD-LL-TI-009)
336 ACSR aerial	12	1	0.6080	3.5202	0.3778	2.1874	AM-FM Impedance Calculator (WHC-SD-LL-TI-009)
336 ACSR aerial	12	3	0.6107	3.4740	0.3795	2.1587	AM-FM Impedance Calculator (WHC-SD-LL-TI-009)
336 ACSR aerial	12	4	0.6078	3.4896	0.3777	2.1683	AM-FM Impedance Calculator (WHC-SD-LL-TI-009)
2-477 ACSR aerial	16	2||7	0.4040	3.3945	0.2510	2.1093	L. Holleman calculations of Sept 95
15-kV Bus			0.3701	0.1794	0.2300	0.1115	Same as 15-kV bus positive sequence

Table B-3. Voltage Regulation Summary.

TWRS Phase I Privatization Facilities Alternative 1 Load Flow Results

	Case 1A		Case 1B		Case 1C		Case 1D		Case 2	
Location	**Voltage**	**% Drop**	**Voltage**	**% Drop**	**Voltage**	**% Drop**	**Voltage**	**% Drop**	**Voltage**	**% Drop**
1900	13,888	-0.6	13,606	1.4	13,138	4.8	12,176	11.8	13,829	-0.2
2900	13,876	-0.5	13,587	1.5	13,100	5.1	12,053	12.7	13,826	-0.2
3900									13,829	-0.2
4900									13,826	-0.2
5900	13,907	-0.7	13,622	1.3	13,157	4.7	12,200	11.6		
8900	13,521	2.0	13,135	4.8	12,470	9.6	10,948	20.7		

All locations represent the Privatization Facility boundary.

Case 1 - Modify two existing express feeders and construct two new express feeders

Case 1A - 5 MVA (-0.95 power factor) on each express feeder.

Case 1B - 6 MVA (-0.95 power factor) on each express feeder.

Case 1C - 7.5 MVA (-0.95 power factor) on each express feeder.

Case 1D - 10 MVA (-0.95 power factor) on each express feeder.

Case 2 - Construct two new express feeders, loaded at 10 MVA (-0.95 power factor) on each express feeder.

B4.0 ALTERNATIVE 1 LOAD FLOW STUDY RESULTS

Table B-3 summarizes the voltage regulation by listing the service voltage at the privatization facilities boundary. Table B-4 lists the privatization facility's service voltage results, according to the studies, and the resulting system load at the 251-W Substation. Using the acceptance criteria for service voltage and the 251-W Substation loading, none of the cases are acceptable.

Table B-4. Alternative 1 Summary Results.

CASE	Privatization Facilities			251-W Substation		Accepted Case
	MW per express feeder	Service Voltage (kV)		Total Load at the substation (34.6 MVA base)[3]	Acceptance Criteria (< 50 MVA)[4]	
		Study Results (worse express line)[1]	Acceptance Criteria (> 13.46 kV)[2]			
1A	5	13.521	YES	54.6	NO	NO
1B	6	13.135	NO	58.6	NO	NO
1C	7.5	12.470	NO	64.6	NO	NO
1D	10	10.948	NO	74.6	NO	NO
2	10	13.826	YES	74.6	NO	NO

Notes
1. Table A-3: Location 8900 experiences the lowest service voltage in Case 1.
2. Section 6.1, Assumption 6 states that 13.46 kV is the minimum acceptable service voltage at the privatization facility.
3. Section 6.1, Assumptions 1 and 2 state that 34.6 MVA as total non-privatization facility load base in 2003.
4. Highest rating of one 230-13.8 kV transformer at 251-W substation.

BASIC CASE 1 MODEL

Primary transformer modeled at 220 kV primary volts with tap of -5 percent. The fault contribution at substation A8 has been modeled at 234.4 kV. 234.4 kV is the regulatory requirement BPA must meet at the WNP #2 start-up transformers (at Ashe Substation). Substation A8 was modeled with 17.3 MVA at -0.95 power factor on each A8 bus (this is the forecasted load for all non-TWRS Phase I facilities for FY 2003). The Case 1 model uses two new express feeders from substation A8 following the line C8L5 corridor using 336 ACSR aerial conductors. Lines C8L5 and C8L8 were modeled as express feeders to the Phase I TWRS privatization site.

Case 1a - each express feeder was loaded with 5 MVA at -0.95 power factor at the Phase I TWRS site.

Study performed by ICF Kaiser Hanford, Utilities Engineering and Technical Services
Richland, Washington

DATE: 6 FEB 96
TIME: 8 08 AM
FILE: LFC1A.R0

ALL INFORMATION PRESENTED IS FOR REVIEW, APPROVAL
INTERPRETATION AND APPLICATION BY A REGISTERED
ENGINEER ONLY

DAPPER (LOAD FLOW AND VOLTAGE DROP MINI/MICRO VERSION 4.5 LEVEL 1.0)

```
          SWING GENERATORS
    BUS NO     ID STAT VOLTAGE  ANGLE
    ================================
       234      1  1     1.00      .00
NOTICE: BRANCH    -1 A8 SUB     TO  230 A8 SUB      IS OUT OF SERVICE
NOTICE: BRANCH   230 A8 SUB     TO  100 A2702C SEC IS OUT OF SERVICE
NOTICE: BRANCH   230 A8 SUB     TO  200 A2703C SEC IS OUT OF SERVICE
```

FEEDER DATA

FEEDER FROM NO	NAME	FEEDER TO NO	NAME	QTY /PH	VOLTS L-L	LENGTH	FEEDER SIZE	TYPE	DESCRIPTION DUCT	INSUL
1	A8 BUS 1	5	C8X5	1	13800.	1. M				
	IMPEDANCE:	.0230 + J .1115 OHMS/M				METERS				
1	A8 BUS 1	10	C8XNEW1	1	13800.	1. M				
	IMPEDANCE:	.0230 + J .1115 OHMS/M				METERS				
2	A8 BUS 2	8	C8X8	1	13800.	1. M				
	IMPEDANCE:	.0230 + J .1115 OHMS/M				METERS				
2	A8 BUS 2	20	C8XNEW2	1	13800.	1. M				
	IMPEDANCE:	.0230 + J .1115 OHMS/M				METERS				
5	C8X5	5000	L5 RISER	1	13800.	46. M				
	IMPEDANCE:	.0709 + J .1174 OHMS/M				METERS				
8	C8X8	8000	L8 RISER	1	13800.	87. M				
	IMPEDANCE:	.0709 + J .1174 OHMS/M				METERS				
10	C8XNEW1	1000	NEW1 RISER	1	13800.	87. M				
	IMPEDANCE:	.0709 + J .1174 OHMS/M				METERS				
20	C8XNEW2	2000	NEW2 RISER	1	13800.	87. M				
	IMPEDANCE:	.0709 + J .1174 OHMS/M				METERS				
100	A2702C SEC	1	A8 BUS 1	3	13800.	53. M				
	IMPEDANCE:	.0230 + J .1115 OHMS/M				METERS				
200	A2703C SEC	2	A8 BUS 2	3	13800.	53. M				
	IMPEDANCE:	.0230 + J .1116 OHMS/M				METERS				
1000	NEW1 RISER	1800	8TH STREET	1	13800.	6148. M				
	IMPEDANCE:	.2000 + J .3965 OHMS/M				METERS				
1800	8TH STREET	1900	TWRS #2	1	13800.	800. M				
	IMPEDANCE:	.2001 + J .3965 OHMS/M				METERS				
2000	NEW2 RISER	2800	8TH STREET	1	13800.	6148. M				
	IMPEDANCE:	.2001 + J .3965 OHMS/M				METERS				
2800	8TH STREET	2900	TWRS #1	1	13800.	800. M				
	IMPEDANCE:	.2001 + J .3965 OHMS/M				METERS				
5000	L5 RISER	5200	C8X110	1	13800.	4731. M				
	IMPEDANCE:	.1883 + J .4135 OHMS/M				METERS				

F E E D E R   D A T A

FEEDER FROM NO NAME	FEEDER TO NO NAME	QTY /PH	VOLTS L-L	LENGTH	FEEDER SIZE TYPE	DESCRIPTION DUCT	INSUL
5200 C8X110	5800 8TH STREET	1	13800.	1417. M			
IMPEDANCE:	.1884 + J .4136 OHMS/M METERS						
5800 8TH STREET	5900 TWRS #1	1	13800.	800. M			
IMPEDANCE:	.2001 + J .3965 OHMS/M METERS						
8000 L8 RISER	8200 C8X294	1	13800.	6942. M			
IMPEDANCE:	.2001 + J .3774 OHMS/M METERS						
8200 C8X294	8700 EXT #1	1	13800.	1372. M			
IMPEDANCE:	.2000 + J .3865 OHMS/M METERS						
8700 EXT #1	8750 OLD C8L5	1	13800.	91. M			
IMPEDANCE:	.2007 + J .3982 OHMS/M METERS						
8750 OLD C8L5	8800 8TH STREET	1	13800.	606. M			
IMPEDANCE:	.1883 + J .4134 OHMS/M METERS						
8800 8TH STREET	8900 TWRS #2	1	13800.	800. M			
IMPEDANCE:	.2001 + J .3965 OHMS/M METERS						

SOURCE BUS THEVENIN EQUIVALENT IMPEDANCE: 1.278144000 + J11.277260000 OHMS
Calculated From Utility Contribution at Bus No. 234

TRANSFORMER DATA

PRIMARY RECORD NO NAME	VOLTS L-L	PRI FLA	* SECONDARY RECORD NO NAME	VOLTS L-L	SEC FLA	NOMINAL KVA
234 BPA	220000.	79.	100 A2702C SEC	13800.	1255.	30000.0
IMPEDANCE:	.4092 + J13.8340 PERCENT		TRANSFORMER FIXED TAP:			-5.0 %
234 BPA	220000.	79.	200 A2703C SEC	13800.	1255.	30000.0
IMPEDANCE:	.3941 + J13.8944 PERCENT		TRANSFORMER FIXED TAP:			-5.0 %
8999 ZIGZAG #2	13800.	69.	200 A2703C SEC	13800.	69.	1657.0
IMPEDANCE:	.4000 + J 3.1067 PERCENT					
9999 ZIGZAG #1	13800.	69.	100 A2702C SEC	13800.	69.	1657.0
IMPEDANCE:	.4000 + J 3.1067 PERCENT					

B R A N C H   L O A D   D A T A

FROM BUS / TO BUS	BR. TYPE	CONSTANT KVA KVA	CONSTANT KVA %PF	CONSTANT Z KVA	CONSTANT Z %PF	CONSTANT I KVA	CONSTANT I %PF	FLOW DIR.
1 A8 BUS 1								
5 C8X5	FEEDER	5000	-95.0					
10 C8XNEW1	FEEDER	5000	-95.0					
2 A8 BUS 2								
8 C8X8	FEEDER	5000	-95.0					
20 C8XNEW2	FEEDER	5000	-95.0					
5 C8X5								
5000 L5 RISER	FEEDER	5000	-95.0					
8 C8X8								
8000 L8 RISER	FEEDER	5000	-95.0					
10 C8XNEW1								
1000 NEW1 RISER	FEEDER	5000	-95.0					
20 C8XNEW2								
2000 NEW2 RISER	FEEDER	5000	-95.0					
100 A2702C SEC								
1 A8 BUS 1	FEEDER	27263	-95.0					
200 A2703C SEC								
2 A8 BUS 2	FEEDER	27263	-95.0					
1000 NEW1 RISER								
1800 8TH STREET	FEEDER	5000	-95.0					
1800 8TH STREET								
1900 TWRS #2	FEEDER	5000	-95.0					
2000 NEW2 RISER								
2800 8TH STREET	FEEDER	5000	-95.0					
2800 8TH STREET								
2900 TWRS #1	FEEDER	5000	-95.0					
5000 L5 RISER								
5200 C8X110	FEEDER	5000	-95.0					
5200 C8X110								
5800 8TH STREET	FEEDER	5000	-95.0					

B R A N C H   L O A D   D A T A

F R O M B U S	/ T O / B U S	BR. TYPE	CONSTANT KVA KVA	CONSTANT KVA %PF	CONSTANT Z KVA	CONSTANT Z %PF	CONSTANT I KVA	CONSTANT I %PF	FLOW DIR.
5800 8TH STREET	5900 TWRS #1	FEEDER	5000	-95.0					
8000 L8 RISER	8200 C8X294	FEEDER	5000	-95.0					
8200 C8X294	8700 EXT #1	FEEDER	5000	-95.0					
8700 EXT #1	8750 OLD C8L5	FEEDER	5000	-95.0					
8750 OLD C8L5	8800 8TH STREET	FEEDER	5000	-95.0					
8800 8TH STREET	8900 TWRS #2	FEEDER	5000	-95.0					
234 BPA	100 A2702C	SEC TRANS.	27263	-95.0					
	200 A2703C	SEC TRANS.	27263	-95.0					

```
*** SOLUTION COMMENTS ***
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SOLUTION PARAMETERS

BRANCH VOLTAGE CRITERIA                      :  4.00 %
BUS VOLTAGE CRITERIA                         :  5.00 %
ACCELERATION FACTOR FOR 'PV' GENERATORS      :  1.00
ACCELERATION FACTOR FOR CONSTANT KVA LOADS:     1.00
EXACT(ITERATIVE) SOLUTION                    :  YES

<<PERCENT VOLTAGE DROPS ARE BASED ON NOMINAL DESIGN VOLTAGES>>

TOF SIZE:   82

LARGEST LOAD:           17263.20 KVA
CONVERGENCE CRITERIA:       .863 KVA
LARGEST BUS MISMATCH      1  A8 BUS 1          2131.411 KVA
LARGEST BUS MISMATCH      1  A8 BUS 1           169.502 KVA
LARGEST BUS MISMATCH      1  A8 BUS 1            21.846 KVA
LARGEST BUS MISMATCH      1  A8 BUS 1             3.454 KVA
LARGEST BUS MISMATCH      1  A8 BUS 1              .580 KVA
```

BALANCED VOLTAGE DROP AND LOAD FLOW ANALYSIS (SWING GENERATORS)

****

BUS	VOLTS(PU)	ANGLE	KW	KVAR	VD%	R + JX (PU)
234	1.000	.00	52869.	25701.	.6	.00233 + J .02053

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                BALANCED VOLTAGE DROP AND LOAD FLOW ANALYSIS
*****************************************************************************
VOLTAGE EFFECT ON LOADS MODELED
VOLTAGE DROP CRITERIA: BRANCH =  4.00 %   BUS =  5.00


==== BUS:     1 A8 BUS 1   DESIGN VOLTAGE: 13800  BUS VOLTAGE: 14698 %VD: -6.5
======================== PU BUS VOLTAGE:    1.07         ANGLE:  -6.4 DEGREES
               NET BRANCH DIVERSITY LOAD:  16400. KW   5390. KVAR

LOAD   TO:     5 C8X5          FEEDER AMPS:   208 VOLTAGE DROP:     0. %VD:    .0
PROJECTED POWER FLOW:  4921. KW  1932. KVAR  5287. KVA    PF:    .93   LAGGING
LOSSES THRU FEEDER:        0. KW        0. KVAR        0. KVA

LOAD   TO:    10 C8XNEW1       FEEDER AMPS:   208 VOLTAGE DROP:     0. %VD:    .0
PROJECTED POWER FLOW:  4931. KW  1920. KVAR  5291. KVA    PF:    .93   LAGGING
LOSSES THRU FEEDER:        0. KW        0. KVAR        0. KVA

LOAD FROM:  100 A2702C SEC   FEEDER AMPS:  1093 VOLTAGE DROP:     2. %VD:    .0
PROJECTED POWER FLOW: 26252. KW  9242. KVAR 27831. KVA    PF:    .94   LAGGING
LOSSES THRU FEEDER:        1. KW        7. KVAR        7. KVA


==== BUS:     2 A8 BUS 2   DESIGN VOLTAGE: 13800  BUS VOLTAGE: 14686 %VD: -6.4
======================== PU BUS VOLTAGE:    1.06         ANGLE:  -6.5 DEGREES
               NET BRANCH DIVERSITY LOAD:  16400. KW   5390. KVAR

LOAD   TO:     8 C8X8          FEEDER AMPS:   213 VOLTAGE DROP:     0. %VD:    .0
PROJECTED POWER FLOW:  5018. KW  2076. KVAR  5431. KVA    PF:    .92   LAGGING
LOSSES THRU FEEDER:        0. KW        0. KVAR        0. KVA

LOAD   TO:    20 C8XNEW2       FEEDER AMPS:   208 VOLTAGE DROP:     0. %VD:    .0
PROJECTED POWER FLOW:  4931. KW  1920. KVAR  5292. KVA    PF:    .93   LAGGING
LOSSES THRU FEEDER:        0. KW        0. KVAR        0. KVA

LOAD FROM:  200 A2703C SEC   FEEDER AMPS:  1100 VOLTAGE DROP:     2. %VD:    .0
PROJECTED POWER FLOW: 26350. KW  9387. KVAR 27972. KVA    PF:    .94   LAGGING
LOSSES THRU FEEDER:        1. KW        7. KVAR        7. KVA


==== BUS:     5 C8X5       DESIGN VOLTAGE: 13800  BUS VOLTAGE: 14698 %VD: -6.5
======================== PU BUS VOLTAGE:    1.07         ANGLE:  -6.4 DEGREES

LOAD FROM:     1 A8 BUS 1    FEEDER AMPS:   208 VOLTAGE DROP:     0. %VD:    .0
PROJECTED POWER FLOW:  4921. KW  1932. KVAR  5287. KVA    PF:    .93   LAGGING
LOSSES THRU FEEDER:        0. KW        0. KVAR        0. KVA
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                BALANCED VOLTAGE DROP AND LOAD FLOW ANALYSIS
*****************************************************************************
VOLTAGE EFFECT ON LOADS MODELED
VOLTAGE DROP CRITERIA: BRANCH =  4.00 %   BUS =  5.00


LOAD   TO: 5000 L5 RISER      FEEDER AMPS:   208 VOLTAGE DROP:    2. %VD:   .0
PROJECTED POWER FLOW:  4921. KW  1932. KVAR  5287. KVA    PF:   .93  LAGGING
LOSSES THRU FEEDER:         0. KW        1. KVAR       1. KVA


==== BUS:    8 C8X8        DESIGN VOLTAGE: 13800  BUS VOLTAGE: 14686 %VD: -6.4
========================= PU BUS VOLTAGE:   1.06        ANGLE:  -6.5 DEGREES

LOAD FROM:    2 A8 BUS 2      FEEDER AMPS:   213 VOLTAGE DROP:    0. %VD:   .0
PROJECTED POWER FLOW:  5018. KW  2076. KVAR  5431. KVA    PF:   .92  LAGGING
LOSSES THRU FEEDER:         0. KW        0. KVAR       0. KVA

LOAD   TO: 8000 L8 RISER      FEEDER AMPS:   213 VOLTAGE DROP:    4. %VD:   .0
PROJECTED POWER FLOW:  5018. KW  2076. KVAR  5431. KVA    PF:   .92  LAGGING
LOSSES THRU FEEDER:         1. KW        1. KVAR       2. KVA


==== BUS:   10 C8XNEW1     DESIGN VOLTAGE: 13800  BUS VOLTAGE: 14698 %VD: -6.5
========================= PU BUS VOLTAGE:   1.07        ANGLE:  -6.4 DEGREES

LOAD FROM:    1 A8 BUS 1      FEEDER AMPS:   208 VOLTAGE DROP:    0. %VD:   .0
PROJECTED POWER FLOW:  4931. KW  1920. KVAR  5291. KVA    PF:   .93  LAGGING
LOSSES THRU FEEDER:         0. KW        0. KVAR       0. KVA

LOAD   TO: 1000 NEW1 RISER    FEEDER AMPS:   208 VOLTAGE DROP:    3. %VD:   .0
PROJECTED POWER FLOW:  4931. KW  1920. KVAR  5291. KVA    PF:   .93  LAGGING
LOSSES THRU FEEDER:         1. KW        1. KVAR       2. KVA


==== BUS:   20 C8XNEW2     DESIGN VOLTAGE: 13800  BUS VOLTAGE: 14686 %VD: -6.4
========================= PU BUS VOLTAGE:   1.06        ANGLE:  -6.5 DEGREES

LOAD FROM:    2 A8 BUS 2      FEEDER AMPS:   208 VOLTAGE DROP:    0. %VD:   .0
PROJECTED POWER FLOW:  4931. KW  1920. KVAR  5292. KVA    PF:   .93  LAGGING
LOSSES THRU FEEDER:         0. KW        0. KVAR       0. KVA

LOAD   TO: 2000 NEW2 RISER    FEEDER AMPS:   208 VOLTAGE DROP:    3. %VD:   .0
PROJECTED POWER FLOW:  4931. KW  1920. KVAR  5292. KVA    PF:   .93  LAGGING
LOSSES THRU FEEDER:         1. KW        1. KVAR       2. KVA
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                BALANCED VOLTAGE DROP AND LOAD FLOW ANALYSIS
*******************************************************************************
VOLTAGE EFFECT ON LOADS MODELED
VOLTAGE DROP CRITERIA: BRANCH =  4.00 %   BUS =  5.00


==== BUS:  100 A2702C SEC DESIGN VOLTAGE: 13800  BUS VOLTAGE: 14700 %VD: -6.5
======================== PU BUS VOLTAGE:   1.07        ANGLE:  -6.4 DEGREES

LOAD   TO:    1 A8 BUS 1     FEEDER AMPS:  1093 VOLTAGE DROP:    2. %VD:    .0
PROJECTED POWER FLOW: 26253. KW  9249. KVAR 27835. KVA    PF:   .94   LAGGING
LOSSES THRU FEEDER:         1. KW       7. KVAR       7. KVA

LOAD FROM:  234 BPA          TRANSF AMPS:  1093 VOLTAGE DROP: -989. %VD: -7.2
PROJECTED POWER FLOW: 26253. KW  9249. KVAR 27835. KVA    PF:   .94   LAGGING
LOSSES THRU TRANSF:      93.1 KW 3148.9 KVAR 3150.3 KVA ***XFMR TAPS  -5.0%***

LOAD FROM: 9999 ZIGZAG #1    TRANSF AMPS:        VOLTAGE DROP:    0. %VD:    .0
PROJECTED POWER FLOW:      0. KW      0. KVAR      0. KVA    PF:   .00   LAGGING
LOSSES THRU TRANSF:        .0 KW      .0 KVAR     .0 KVA


==== BUS:  200 A2703C SEC DESIGN VOLTAGE: 13800  BUS VOLTAGE: 14688 %VD: -6.4
======================== PU BUS VOLTAGE:   1.06        ANGLE:  -6.4 DEGREES

LOAD   TO:    2 A8 BUS 2     FEEDER AMPS:  1100 VOLTAGE DROP:    2. %VD:    .0
PROJECTED POWER FLOW: 26351. KW  9394. KVAR 27976. KVA    PF:   .94   LAGGING
LOSSES THRU FEEDER:         1. KW       7. KVAR       7. KVA

LOAD FROM:  234 BPA          TRANSF AMPS:  1100 VOLTAGE DROP: -977. %VD: -7.1
PROJECTED POWER FLOW: 26351. KW  9394. KVAR 27976. KVA    PF:   .94   LAGGING
LOSSES THRU TRANSF:      90.8 KW 3199.6 KVAR 3200.9 KVA ***XFMR TAPS  -5.0%***

LOAD FROM: 8999 ZIGZAG #2    TRANSF AMPS:        VOLTAGE DROP:    0. %VD:    .0
PROJECTED POWER FLOW:      0. KW      0. KVAR      0. KVA    PF:   .00   LAGGING
LOSSES THRU TRANSF:        .0 KW      .0 KVAR     .0 KVA


==== BUS:  234 BPA          DESIGN VOLTAGE:234400  BUS VOLTAGE:232888 %VD:    .6
======================== PU BUS VOLTAGE:    .99        ANGLE:   -.6 DEGREES
           *** SWING  GENERATOR:    1      52869. KW     25701. KVAR

LOAD   TO:  100 A2702C SEC   TRANSF AMPS:    72 VOLTAGE DROP:****** %VD: -7.2
PROJECTED POWER FLOW: 26347. KW 12398. KVAR 29118. KVA    PF:   .90   LAGGING
LOSSES THRU TRANSF:      93.1 KW 3148.9 KVAR 3150.3 KVA ***XFMR TAPS  -5.0%***

LOAD   TO:  200 A2703C SEC   TRANSF AMPS:    73 VOLTAGE DROP:****** %VD: -7.1
PROJECTED POWER FLOW: 26442. KW 12594. KVAR 29288. KVA    PF:   .90   LAGGING
LOSSES THRU TRANSF:      90.8 KW 3199.6 KVAR 3200.9 KVA ***XFMR TAPS  -5.0%***
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                 BALANCED VOLTAGE DROP AND LOAD FLOW ANALYSIS
*****************************************************************************
VOLTAGE EFFECT ON LOADS MODELED
VOLTAGE DROP CRITERIA: BRANCH =  4.00 %   BUS =  5.00


LOAD FROM: **** SOURCE INT   FEEDER AMPS:   145 VOLTAGE DROP: 1512. %VD:    .6
PROJECTED POWER FLOW: 52788. KW 24992. KVAR 58406. KVA    PF:   .90  LAGGING
LOSSES THRU FEEDER:      80. KW     709. KVAR    714. KVA


==== BUS: 1000 NEW1 RISER DESIGN VOLTAGE: 13800  BUS VOLTAGE: 14694 %VD: -6.5
========================= PU BUS VOLTAGE:   1.06        ANGLE:  -6.4 DEGREES

LOAD FROM:   10 C8XNEW1      FEEDER AMPS:   208 VOLTAGE DROP:    3. %VD:    .0
PROJECTED POWER FLOW:  4930. KW  1918. KVAR  5290. KVA    PF:   .93  LAGGING
LOSSES THRU FEEDER:       1. KW       1. KVAR      2. KVA

LOAD   TO: 1800 8TH STREET   FEEDER AMPS:   208 VOLTAGE DROP:  715. %VD:   5.2$
PROJECTED POWER FLOW:  4930. KW  1918. KVAR  5290. KVA    PF:   .93  LAGGING
LOSSES THRU FEEDER:     159. KW     316. KVAR    354. KVA


==== BUS: 1800 8TH STREET DESIGN VOLTAGE: 13800  BUS VOLTAGE: 13979 %VD: -1.3
========================= PU BUS VOLTAGE:   1.01        ANGLE:  -9.1 DEGREES

LOAD FROM: 1000 NEW1 RISER   FEEDER AMPS:   208 VOLTAGE DROP:  715. %VD:   5.2$
PROJECTED POWER FLOW:  4771. KW  1602. KVAR  5033. KVA    PF:   .95  LAGGING
LOSSES THRU FEEDER:     159. KW     316. KVAR    354. KVA

LOAD   TO: 1900 TWRS #2      FEEDER AMPS:   208 VOLTAGE DROP:   91. %VD:    .7
PROJECTED POWER FLOW:  4771. KW  1602. KVAR  5033. KVA    PF:   .95  LAGGING
LOSSES THRU FEEDER:      21. KW      41. KVAR     46. KVA


==== BUS: 1900 TWRS #2    DESIGN VOLTAGE: 13800  BUS VOLTAGE: 13888 %VD:  -.6
========================= PU BUS VOLTAGE:   1.01        ANGLE:  -9.5 DEGREES
                NET BRANCH DIVERSITY LOAD:   4750. KW   1561. KVAR

LOAD FROM: 1800 8TH STREET   FEEDER AMPS:   208 VOLTAGE DROP:   91. %VD:    .7
PROJECTED POWER FLOW:  4750. KW  1561. KVAR  5000. KVA    PF:   .95  LAGGING
LOSSES THRU FEEDER:      21. KW      41. KVAR     46. KVA
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                BALANCED VOLTAGE DROP AND LOAD FLOW ANALYSIS
*****************************************************************************
VOLTAGE EFFECT ON LOADS MODELED
VOLTAGE DROP CRITERIA: BRANCH =  4.00 %   BUS =  5.00


==== BUS: 2000 NEW2 RISER DESIGN VOLTAGE: 13800  BUS VOLTAGE: 14683 %VD: -6.4
======================== PU BUS VOLTAGE:   1.06       ANGLE:  -6.5 DEGREES

LOAD FROM:   20 C8XNEW2      FEEDER AMPS:   208 VOLTAGE DROP:    3. %VD:   .0
PROJECTED POWER FLOW:  4931. KW  1919. KVAR  5291. KVA    PF:   .93  LAGGING
LOSSES THRU FEEDER:        1. KW      1. KVAR      2. KVA

LOAD   TO: 2800 8TH STREET   FEEDER AMPS:   208 VOLTAGE DROP:  716. %VD:  5.2$
PROJECTED POWER FLOW:  4931. KW  1919. KVAR  5291. KVA    PF:   .93  LAGGING
LOSSES THRU FEEDER:      160. KW    317. KVAR    355. KVA


==== BUS: 2800 8TH STREET DESIGN VOLTAGE: 13800  BUS VOLTAGE: 13967 %VD: -1.2
======================== PU BUS VOLTAGE:   1.01       ANGLE:  -9.2 DEGREES

LOAD FROM: 2000 NEW2 RISER   FEEDER AMPS:   208 VOLTAGE DROP:  716. %VD:  5.2$
PROJECTED POWER FLOW:  4771. KW  1602. KVAR  5033. KVA    PF:   .95  LAGGING
LOSSES THRU FEEDER:      160. KW    317. KVAR    355. KVA

LOAD   TO: 2900 TWRS #1      FEEDER AMPS:   208 VOLTAGE DROP:   91. %VD:   .7
PROJECTED POWER FLOW:  4771. KW  1602. KVAR  5033. KVA    PF:   .95  LAGGING
LOSSES THRU FEEDER:       21. KW     41. KVAR     46. KVA


==== BUS: 2900 TWRS #1    DESIGN VOLTAGE: 13800  BUS VOLTAGE: 13876 %VD:  -.5
======================== PU BUS VOLTAGE:   1.01       ANGLE:  -9.5 DEGREES
                  NET BRANCH DIVERSITY LOAD:   4750. KW   1561. KVAR

LOAD FROM: 2800 8TH STREET   FEEDER AMPS:   208 VOLTAGE DROP:   91. %VD:   .7
PROJECTED POWER FLOW:  4750. KW  1561. KVAR  5000. KVA    PF:   .95  LAGGING
LOSSES THRU FEEDER:       21. KW     41. KVAR     46. KVA


==== BUS: 5000 L5 RISER   DESIGN VOLTAGE: 13800  BUS VOLTAGE: 14696 %VD: -6.5
======================== PU BUS VOLTAGE:   1.06       ANGLE:  -6.4 DEGREES

LOAD FROM:    5 C8X5         FEEDER AMPS:   208 VOLTAGE DROP:    2. %VD:   .0
PROJECTED POWER FLOW:  4921. KW  1931. KVAR  5286. KVA    PF:   .93  LAGGING
LOSSES THRU FEEDER:        0. KW      1. KVAR      1. KVA

LOAD   TO: 5200 C8X110       FEEDER AMPS:   208 VOLTAGE DROP:  545. %VD:  4.0
PROJECTED POWER FLOW:  4921. KW  1931. KVAR  5286. KVA    PF:   .93  LAGGING
LOSSES THRU FEEDER:      115. KW    253. KVAR    278. KVA
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              BALANCED VOLTAGE DROP AND LOAD FLOW ANALYSIS
******************************************************************************
VOLTAGE EFFECT ON LOADS MODELED
VOLTAGE DROP CRITERIA: BRANCH =  4.00 %   BUS =  5.00


==== BUS: 5200 C8X110      DESIGN VOLTAGE: 13800  BUS VOLTAGE: 14151 %VD: -2.5
========================= PU BUS VOLTAGE:    1.03        ANGLE:  -8.6 DEGREES

LOAD FROM: 5000 L5 RISER     FEEDER AMPS:   208 VOLTAGE DROP:  545. %VD:  4.0
PROJECTED POWER FLOW:  4805. KW  1678. KVAR  5090. KVA    PF:   .94  LAGGING
LOSSES THRU FEEDER:      115. KW     253. KVAR     278. KVA

LOAD   TO: 5800 8TH STREET   FEEDER AMPS:   208 VOLTAGE DROP:  159. %VD:  1.2
PROJECTED POWER FLOW:  4805. KW  1678. KVAR  5090. KVA    PF:   .94  LAGGING
LOSSES THRU FEEDER:       35. KW      76. KVAR      83. KVA


==== BUS: 5800 8TH STREET DESIGN VOLTAGE: 13800  BUS VOLTAGE: 13991 %VD: -1.4
========================= PU BUS VOLTAGE:    1.01        ANGLE:  -9.3 DEGREES

LOAD FROM: 5200 C8X110       FEEDER AMPS:   208 VOLTAGE DROP:  159. %VD:  1.2
PROJECTED POWER FLOW:  4771. KW  1602. KVAR  5033. KVA    PF:   .95  LAGGING
LOSSES THRU FEEDER:       35. KW      76. KVAR      83. KVA

LOAD   TO: 5900 TWRS #1      FEEDER AMPS:   208 VOLTAGE DROP:   91. %VD:   .7
PROJECTED POWER FLOW:  4771. KW  1602. KVAR  5033. KVA    PF:   .95  LAGGING
LOSSES THRU FEEDER:       21. KW      41. KVAR      46. KVA


==== BUS: 5900 TWRS #1     DESIGN VOLTAGE: 13800  BUS VOLTAGE: 13901 %VD:  -.7
========================= PU BUS VOLTAGE:    1.01        ANGLE:  -9.6 DEGREES
                NET BRANCH DIVERSITY LOAD:   4750. KW   1561. KVAR

LOAD FROM: 5800 8TH STREET   FEEDER AMPS:   208 VOLTAGE DROP:   91. %VD:   .7
PROJECTED POWER FLOW:  4750. KW  1561. KVAR  5000. KVA    PF:   .95  LAGGING
LOSSES THRU FEEDER:       21. KW      41. KVAR      46. KVA


==== BUS: 8000 L8 RISER    DESIGN VOLTAGE: 13800  BUS VOLTAGE: 14683 %VD: -6.4
========================= PU BUS VOLTAGE:    1.06        ANGLE:  -6.5 DEGREES

LOAD FROM:     8 C8X8        FEEDER AMPS:   213 VOLTAGE DROP:    4. %VD:   .0
PROJECTED POWER FLOW:  5017. KW  2075. KVAR  5429. KVA    PF:   .92  LAGGING
LOSSES THRU FEEDER:        1. KW       1. KVAR       2. KVA

LOAD   TO: 8200 C8X294       FEEDER AMPS:   213 VOLTAGE DROP:  827. %VD:  6.0$
PROJECTED POWER FLOW:  5017. KW  2075. KVAR  5429. KVA    PF:   .92  LAGGING
LOSSES THRU FEEDER:      190. KW     358. KVAR     405. KVA
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                BALANCED VOLTAGE DROP AND LOAD FLOW ANALYSIS
*****************************************************************************
VOLTAGE EFFECT ON LOADS MODELED
VOLTAGE DROP CRITERIA: BRANCH =  4.00 %   BUS =  5.00


==== BUS: 8200 C8X294      DESIGN VOLTAGE: 13800  BUS VOLTAGE: 13855 %VD:  -.4
======================== PU BUS VOLTAGE:   1.00       ANGLE:  -9.4 DEGREES

LOAD FROM: 8000 L8 RISER     FEEDER AMPS:   213 VOLTAGE DROP:  827. %VD:  6.0$
PROJECTED POWER FLOW:  4828. KW  1716. KVAR  5124. KVA    PF:   .94  LAGGING
LOSSES THRU FEEDER:     190. KW     358. KVAR     405. KVA

LOAD   TO: 8700 EXT #1       FEEDER AMPS:   213 VOLTAGE DROP:  160. %VD:  1.2
PROJECTED POWER FLOW:  4828. KW  1716. KVAR  5124. KVA    PF:   .94  LAGGING
LOSSES THRU FEEDER:      38. KW      73. KVAR      82. KVA


==== BUS: 8700 EXT #1      DESIGN VOLTAGE: 13800  BUS VOLTAGE: 13695 %VD:    .8
======================== PU BUS VOLTAGE:    .99       ANGLE: -10.0 DEGREES

LOAD FROM: 8200 C8X294       FEEDER AMPS:   213 VOLTAGE DROP:  160. %VD:  1.2
PROJECTED POWER FLOW:  4790. KW  1644. KVAR  5064. KVA    PF:   .95  LAGGING
LOSSES THRU FEEDER:      38. KW      73. KVAR      82. KVA

LOAD   TO: 8750 OLD C8L5     FEEDER AMPS:   213 VOLTAGE DROP:   11. %VD:    .1
PROJECTED POWER FLOW:  4790. KW  1644. KVAR  5064. KVA    PF:   .95  LAGGING
LOSSES THRU FEEDER:       2. KW       5. KVAR       6. KVA


==== BUS: 8750 OLD C8L5    DESIGN VOLTAGE: 13800  BUS VOLTAGE: 13684 %VD:    .8
======================== PU BUS VOLTAGE:    .99       ANGLE: -10.0 DEGREES

LOAD FROM: 8700 EXT #1       FEEDER AMPS:   213 VOLTAGE DROP:   11. %VD:    .1
PROJECTED POWER FLOW:  4787. KW  1639. KVAR  5060. KVA    PF:   .95  LAGGING
LOSSES THRU FEEDER:       2. KW       5. KVAR       6. KVA

LOAD   TO: 8800 8TH STREET   FEEDER AMPS:   213 VOLTAGE DROP:   70. %VD:    .5
PROJECTED POWER FLOW:  4787. KW  1639. KVAR  5060. KVA    PF:   .95  LAGGING
LOSSES THRU FEEDER:      16. KW      34. KVAR      38. KVA


==== BUS: 8800 8TH STREET DESIGN VOLTAGE: 13800  BUS VOLTAGE: 13614 %VD:  1.3
======================== PU BUS VOLTAGE:    .99       ANGLE: -10.3 DEGREES

LOAD FROM: 8750 OLD C8L5     FEEDER AMPS:   213 VOLTAGE DROP:   70. %VD:    .5
PROJECTED POWER FLOW:  4772. KW  1605. KVAR  5034. KVA    PF:   .95  LAGGING
LOSSES THRU FEEDER:      16. KW      34. KVAR      38. KVA
```

```
                BALANCED VOLTAGE DROP AND LOAD FLOW ANALYSIS
******************************************************************************
VOLTAGE EFFECT ON LOADS MODELED
VOLTAGE DROP CRITERIA: BRANCH =  4.00 %   BUS =  5.00


LOAD   TO: 8900 TWRS #2      FEEDER AMPS:   213 VOLTAGE DROP:   93. %VD:   .7
PROJECTED POWER FLOW:  4772. KW  1605. KVAR  5034. KVA    PF:   .95  LAGGING
LOSSES THRU FEEDER:      22. KW      43. KVAR      49. KVA


==== BUS: 8900 TWRS #2    DESIGN VOLTAGE: 13800  BUS VOLTAGE: 13521 %VD:  2.0
========================= PU BUS VOLTAGE:    .98       ANGLE: -10.7 DEGREES
               NET BRANCH DIVERSITY LOAD:   4750. KW   1561. KVAR

LOAD FROM: 8800 8TH STREET   FEEDER AMPS:   213 VOLTAGE DROP:   93. %VD:   .7
PROJECTED POWER FLOW:  4750. KW  1561. KVAR  5000. KVA    PF:   .95  LAGGING
LOSSES THRU FEEDER:      22. KW      43. KVAR      49. KVA


==== BUS: 8999 ZIGZAG #2  DESIGN VOLTAGE: 13800  BUS VOLTAGE: 14688 %VD: -6.4
========================= PU BUS VOLTAGE:   1.06       ANGLE:  -6.4 DEGREES
**** NO LOAD SPECIFIED ****


==== BUS: 9999 ZIGZAG #1  DESIGN VOLTAGE: 13800  BUS VOLTAGE: 14700 %VD: -6.5
========================= PU BUS VOLTAGE:   1.07       ANGLE:  -6.4 DEGREES
**** NO LOAD SPECIFIED ****
```

BALANCED VOLTAGE DROP AND LOAD FLOW BUS DATA SUMMARY

BUS#	NAME	BASE VOLT	PU VOLT	BUS#	NAME	BASE VOLT	PU VOLT
1	A8 BUS 1	13800.00	1.0650	2	A8 BUS 2	13800.00	1.0642
5	C8X5	13800.00	1.0650	8	C8X8	13800.00	1.0642
10	C8XNEW1	13800.00	1.0650	20	C8XNEW2	13800.00	1.0642
100	A2702C SEC	13800.00	1.0652	200	A2703C SEC	13800.00	1.0644
234	BPA	234400.00	.9935	1000	NEW1 RISER	13800.00	1.0648
1800	8TH STREET	13800.00	1.0130	1900	TWRS #2	13800.00	1.0064
2000	NEW2 RISER	13800.00	1.0640	2800	8TH STREET	13800.00	1.0121
2900	TWRS #1	13800.00	1.0055	5000	L5 RISER	13800.00	1.0649
5200	C8X110	13800.00	1.0254	5800	8TH STREET	13800.00	1.0139
5900	TWRS #1	13800.00	1.0073	8000	L8 RISER	13800.00	1.0640
8200	C8X294	13800.00	1.0040	8700	EXT #1	13800.00	.9924
8750	OLD C8L5	13800.00	.9916	8800	8TH STREET	13800.00	.9866
8900	TWRS #2	13800.00	.9798	8999	ZIGZAG #2	13800.00	1.0644

BALANCED VOLTAGE DROP AND LOAD FLOW BRANCH DATA SUMMARY

FROM	NAME	TO	NAME	TYPE	VD%	AMPS	KVA	RATING%
1	A8 BUS 1	5	C8X5	FDR	.00	207.67	5286.61	34.61
1	A8 BUS 1	10	C8XNEW1	FDR	.00	207.86	5291.45	34.64
1	A8 BUS 1	100	A2702C SEC	FDR	.01	1093.27	27831.31	52.06
2	A8 BUS 2	8	C8X8	FDR	.00	213.50	5430.77	35.58
2	A8 BUS 2	20	C8XNEW2	FDR	.00	208.04	5292.02	34.67
2	A8 BUS 2	200	A2703C SEC	FDR	.01	1099.64	27971.72	52.36
5	C8X5	1	A8 BUS 1	FDR	.00	207.67	5286.60	34.61
5	C8X5	5000	L5 RISER	FDR	.01	207.67	5286.60	38.46
8	C8X8	2	A8 BUS 2	FDR	.00	213.50	5430.76	35.58
8	C8X8	8000	L8 RISER	FDR	.03	213.50	5430.76	35.58
10	C8XNEW1	1	A8 BUS 1	FDR	.00	207.86	5291.44	34.64
10	C8XNEW1	1000	NEW1 RISER	FDR	.02	207.86	5291.44	34.64
20	C8XNEW2	2	A8 BUS 2	FDR	.00	208.04	5292.01	34.67
20	C8XNEW2	2000	NEW2 RISER	FDR	.02	208.04	5292.01	34.67
100	A2702C SEC	1	A8 BUS 1	FDR	.01	1093.27	27835.05	52.06
100	A2702C SEC	234	BPA	TX2	-7.16	1093.27	27835.05	55.67
100	A2702C SEC	9999	ZIGZAG #1	TX2	.00	.00	.00	.00
200	A2703C SEC	2	A8 BUS 2	FDR	.01	1099.64	27975.53	52.36
200	A2703C SEC	234	BPA	TX2	-7.08	1099.64	27975.53	55.95
200	A2703C SEC	8999	ZIGZAG #2	TX2	.00	.00	.00	.00
234	BPA	100	A2702C SEC	TX2	-7.16	72.19	29117.95	58.24
234	BPA	200	A2703C SEC	TX2	-7.08	72.61	29287.80	58.58
1000	NEW1 RISER	10	C8XNEW1	FDR	.02	207.86	5290.21	34.64

BALANCED VOLTAGE DROP AND LOAD FLOW BRANCH DATA SUMMARY
****

FROM	NAME	TO	NAME	TYPE	VD%	AMPS	KVA	RATING%
1000	NEW1 RISER	1800	8TH STREET	FDR	5.18	207.86	5290.21	34.64
1800	8TH STREET	1000	NEW1 RISER	FDR	5.18	207.86	5032.68	34.64
1800	8TH STREET	1900	TWRS #2	FDR	.66	207.86	5032.68	34.64
1900	TWRS #2	1800	8TH STREET	FDR	.66	207.86	5000.02	34.64
2000	NEW2 RISER	20	C8XNEW2	FDR	.02	208.04	5290.79	34.67
2000	NEW2 RISER	2800	8TH STREET	FDR	5.19	208.04	5290.79	34.67
2800	8TH STREET	2000	NEW2 RISER	FDR	5.19	208.04	5032.73	34.67
2800	8TH STREET	2900	TWRS #1	FDR	.66	208.04	5032.73	34.67
2900	TWRS #1	2800	8TH STREET	FDR	.66	208.04	5000.02	34.67
5000	L5 RISER	5	C8X5	FDR	.01	207.67	5285.96	38.46
5000	L5 RISER	5200	C8X110	FDR	3.95	207.67	5285.96	34.61
5200	C8X110	5000	L5 RISER	FDR	3.95	207.67	5089.86	34.61
5200	C8X110	5800	8TH STREET	FDR	1.15	207.67	5089.86	34.61
5800	8TH STREET	5200	C8X110	FDR	1.15	207.67	5032.62	34.61
5800	8TH STREET	5900	TWRS #1	FDR	.66	207.67	5032.62	34.61
5900	TWRS #1	5800	8TH STREET	FDR	.66	207.67	5000.02	34.61
8000	L8 RISER	8	C8X8	FDR	.03	213.50	5429.45	35.58
8000	L8 RISER	8200	C8X294	FDR	5.99	213.50	5429.45	35.58
8200	C8X294	8000	L8 RISER	FDR	5.99	213.50	5123.57	35.58
8200	C8X294	8700	EXT #1	FDR	1.16	213.50	5123.57	35.58
8700	EXT #1	8200	C8X294	FDR	1.16	213.50	5064.23	35.58
8700	EXT #1	8750	OLD C8L5	FDR	.08	213.50	5064.23	35.58
8750	OLD C8L5	8700	EXT #1	FDR	.08	213.50	5060.26	35.58
8750	OLD C8L5	8800	8TH STREET	FDR	.51	213.50	5060.26	35.58
8800	8TH STREET	8750	OLD C8L5	FDR	.51	213.50	5034.48	35.58
8800	8TH STREET	8900	TWRS #2	FDR	.68	213.50	5034.48	35.58
8900	TWRS #2	8800	8TH STREET	FDR	.68	213.50	5000.02	35.58
8999	ZIGZAG #2	200	A2703C SEC	TX2	.00	.00	.00	.00
9999	ZIGZAG #1	100	A2702C SEC	TX2	.00	.00	.00	.00

NOTE: FOR FEEDERS, RATING% = LOAD FLOW AMPS / FLA.
FLA = LIBRARY FLA EXCLUDING DUCT BANK AND TEMP. DERATING FOR CABLES.
FLA = BRANCH RECORD INPUT FLA FOR IMPEDANCE DATA.

NOTE: FOR TRANSFORMERS, RATING% = LOAD FLOW KVA / TRANSFORMER FULL LOAD KVA.

27 BUSES

*** T O T A L S Y S T E M L O S S E S ***
1069. KW 8675. KVAR

WARNING STUDY CONTAINS 6 VOLTAGE CRITERIA VIOLATIONS
VIOLATIONS DENOTED BY ($) AT BUS AND BRANCH %VD LOCATIONS

BASIC CASE 1 MODEL

Primary transformer modeled at 220 kV primary volts with tap of -5 percent. The fault contribution at substation A8 has been modeled at 234.4 kV. 234.4 kV is the regulatory requirement BPA must meet at the WNP #2 start-up transformers (at Ashe Substation). Substation A8 was modeled with 17.3 MVA at -0.95 power factor on each A8 bus (this is the forecasted load for all non-TWRS Phase I facilities for FY 2003). The Case 1 model uses two new express feeders from substation A8 following the line C8L5 corridor using 336 ACSR aerial conductors. Lines C8L5 and C8L8 were modeled as express feeders to the Phase I TWRS privatization site.

Case 1b - Each express feeder was loaded with 6 MVa at -0.95 power factor at the Phase 1 TWRS site.

Study performed by ICF Kaiser Hanford, Utilities Engineering and Technical Services Richland, Washington

DATE: 6 FEB 96
TIME: 8 11 AM
FILE: LFC1B.RO

ALL INFORMATION PRESENTED IS FOR REVIEW, APPROVAL INTERPRETATION AND APPLICATION BY A REGISTERED ENGINEER ONLY

DAPPER (LOAD FLOW AND VOLTAGE DROP MINI/MICRO VERSION 4.5 LEVEL 1.0)

```
         SWING GENERATORS
   BUS NO     ID STAT VOLTAGE  ANGLE
   ================================
      234      1  1     1.00      .00
NOTICE: BRANCH    -1 A8 SUB      TO  230 A8 SUB      IS OUT OF SERVICE
NOTICE: BRANCH   230 A8 SUB      TO  100 A2702C SEC  IS OUT OF SERVICE
NOTICE: BRANCH   230 A8 SUB      TO  200 A2703C SEC  IS OUT OF SERVICE
```

F E E D E R   D A T A

FEEDER FROM NO	NAME	FEEDER TO NO	NAME	QTY /PH	VOLTS L-L	LENGTH	FEEDER SIZE	TYPE	DESCRIPTION DUCT	INSUL
1	A8 BUS 1	5	C8X5	1	13800.	1. M				
	IMPEDANCE:	.0230 + J .1115 OHMS/M METERS								
1	A8 BUS 1	10	C8XNEW1	1	13800.	1. M				
	IMPEDANCE:	.0230 + J .1115 OHMS/M METERS								
2	A8 BUS 2	8	C8X8	1	13800.	1. M				
	IMPEDANCE:	.0230 + J .1115 OHMS/M METERS								
2	A8 BUS 2	20	C8XNEW2	1	13800.	1. M				
	IMPEDANCE:	.0230 + J .1115 OHMS/M METERS								
5	C8X5	5000	L5 RISER	1	13800.	46. M				
	IMPEDANCE:	.0709 + J .1174 OHMS/M METERS								
8	C8X8	8000	L8 RISER	1	13800.	87. M				
	IMPEDANCE:	.0709 + J .1174 OHMS/M METERS								
10	C8XNEW1	1000	NEW1 RISER	1	13800.	87. M				
	IMPEDANCE:	.0709 + J .1174 OHMS/M METERS								
20	C8XNEW2	2000	NEW2 RISER	1	13800.	87. M				
	IMPEDANCE:	.0709 + J .1174 OHMS/M METERS								
100	A2702C SEC	1	A8 BUS 1	3	13800.	53. M				
	IMPEDANCE:	.0230 + J .1115 OHMS/M METERS								
200	A2703C SEC	2	A8 BUS 2	3	13800.	53. M				
	IMPEDANCE:	.0230 + J .1116 OHMS/M METERS								
1000	NEW1 RISER	1800	8TH STREET	1	13800.	6148. M				
	IMPEDANCE:	.2000 + J .3965 OHMS/M METERS								
1800	8TH STREET	1900	TWRS #2	1	13800.	800. M				
	IMPEDANCE:	.2001 + J .3965 OHMS/M METERS								
2000	NEW2 RISER	2800	8TH STREET	1	13800.	6148. M				
	IMPEDANCE:	.2001 + J .3965 OHMS/M METERS								
2800	8TH STREET	2900	TWRS #1	1	13800.	800. M				
	IMPEDANCE:	.2001 + J .3965 OHMS/M METERS								
5000	L5 RISER	5200	C8X110	1	13800.	4731. M				
	IMPEDANCE:	.1883 + J .4135 OHMS/M METERS								

FEEDER DATA

FEEDER FROM NO NAME	FEEDER TO NO NAME	QTY /PH	VOLTS L-L	LENGTH	FEEDER SIZE TYPE	DESCRIPTION DUCT INSUL
5200 C8X110	5800 8TH STREET	1	13800.	1417. M		
IMPEDANCE:	.1884 + J .4136 OHMS/M METERS					
5800 8TH STREET	5900 TWRS #1	1	13800.	800. M		
IMPEDANCE:	.2001 + J .3965 OHMS/M METERS					
8000 L8 RISER	8200 C8X294	1	13800.	6942. M		
IMPEDANCE:	.2001 + J .3774 OHMS/M METERS					
8200 C8X294	8700 EXT #1	1	13800.	1372. M		
IMPEDANCE:	.2000 + J .3865 OHMS/M METERS					
8700 EXT #1	8750 OLD C8L5	1	13800.	91. M		
IMPEDANCE:	.2007 + J .3982 OHMS/M METERS					
8750 OLD C8L5	8800 8TH STREET	1	13800.	606. M		
IMPEDANCE:	.1883 + J .4134 OHMS/M METERS					
8800 8TH STREET	8900 TWRS #2	1	13800.	800. M		
IMPEDANCE:	.2001 + J .3965 OHMS/M METERS					

SOURCE BUS THEVENIN EQUIVALENT IMPEDANCE: 1.278144000 + J11.277260000 OHMS
Calculated From Utility Contribution at Bus No. 234

T R A N S F O R M E R   D A T A

PRIMARY RECORD NO NAME	VOLTS L-L	PRI FLA	* SECONDARY RECORD NO NAME	VOLTS L-L	SEC FLA	NOMINAL KVA
234 BPA	220000.	79.	100 A2702C SEC	13800.	1255.	30000.0
IMPEDANCE:	.4092 + J13.8340 PERCENT		TRANSFORMER FIXED TAP:			-5.0 %
234 BPA	220000.	79.	200 A2703C SEC	13800.	1255.	30000.0
IMPEDANCE:	.3941 + J13.8944 PERCENT		TRANSFORMER FIXED TAP:			-5.0 %
8999 ZIGZAG #2	13800.	69.	200 A2703C SEC	13800.	69.	1657.0
IMPEDANCE:	.4000 + J 3.1067 PERCENT					
9999 ZIGZAG #1	13800.	69.	100 A2702C SEC	13800.	69.	1657.0
IMPEDANCE:	.4000 + J 3.1067 PERCENT					

B R A N C H   L O A D   D A T A

FROM BUS / TO BUS	BR. TYPE	CONSTANT KVA KVA	CONSTANT KVA %PF	CONSTANT Z KVA	CONSTANT Z %PF	CONSTANT I KVA	CONSTANT I %PF	FLOW DIR.
1 A8 BUS 1								
5 C8X5	FEEDER	6000	-95.0					
10 C8XNEW1	FEEDER	6000	-95.0					
2 A8 BUS 2								
8 C8X8	FEEDER	6000	-95.0					
20 C8XNEW2	FEEDER	6000	-95.0					
5 C8X5								
5000 L5 RISER	FEEDER	6000	-95.0					
8 C8X8								
8000 L8 RISER	FEEDER	6000	-95.0					
10 C8XNEW1								
1000 NEW1 RISER	FEEDER	6000	-95.0					
20 C8XNEW2								
2000 NEW2 RISER	FEEDER	6000	-95.0					
100 A2702C SEC								
1 A8 BUS 1	FEEDER	29263	-95.0					
200 A2703C SEC								
2 A8 BUS 2	FEEDER	29263	-95.0					
1000 NEW1 RISER								
1800 8TH STREET	FEEDER	6000	-95.0					
1800 8TH STREET								
1900 TWRS #2	FEEDER	6000	-95.0					
2000 NEW2 RISER								
2800 8TH STREET	FEEDER	6000	-95.0					
2800 8TH STREET								
2900 TWRS #1	FEEDER	6000	-95.0					
5000 L5 RISER								
5200 C8X110	FEEDER	6000	-95.0					
5200 C8X110								
5800 8TH STREET	FEEDER	6000	-95.0					

BRANCH LOAD DATA

FROM BUS	/ TO / BUS	BR. TYPE	CONSTANT KVA KVA	CONSTANT KVA %PF	CONSTANT Z KVA	CONSTANT Z %PF	CONSTANT I KVA	CONSTANT I %PF	FLOW DIR.
5800 8TH STREET	5900 TWRS #1	FEEDER	6000	-95.0					
8000 L8 RISER	8200 C8X294	FEEDER	6000	-95.0					
8200 C8X294	8700 EXT #1	FEEDER	6000	-95.0					
8700 EXT #1	8750 OLD C8L5	FEEDER	6000	-95.0					
8750 OLD C8L5	8800 8TH STREET	FEEDER	6000	-95.0					
8800 8TH STREET	8900 TWRS #2	FEEDER	6000	-95.0					
234 BPA	100 A2702C	SEC TRANS.	29263	-95.0					
	200 A2703C	SEC TRANS.	29263	-95.0					

```
*** SOLUTION COMMENTS ***
=========================

SOLUTION PARAMETERS

BRANCH VOLTAGE CRITERIA                       :  4.00 %
BUS VOLTAGE CRITERIA                          :  5.00 %
ACCELERATION FACTOR FOR 'PV' GENERATORS       :  1.00
ACCELERATION FACTOR FOR CONSTANT KVA LOADS:      1.00
EXACT(ITERATIVE) SOLUTION                     :  YES

<<PERCENT VOLTAGE DROPS ARE BASED ON NOMINAL DESIGN VOLTAGES>>

TOF SIZE:    82

LARGEST LOAD:             17263.20 KVA
CONVERGENCE CRITERIA:          .863 KVA
LARGEST BUS MISMATCH       1   A8 BUS 1          1944.403 KVA
LARGEST BUS MISMATCH       1   A8 BUS 1           123.599 KVA
LARGEST BUS MISMATCH       1   A8 BUS 1            14.489 KVA
LARGEST BUS MISMATCH       1   A8 BUS 1             2.456 KVA
LARGEST BUS MISMATCH       1   A8 BUS 1              .470 KVA
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BALANCED VOLTAGE DROP AND LOAD FLOW ANALYSIS (SWING GENERATORS)
****

BUS	VOLTS(PU)	ANGLE	KW	KVAR	VD%	R + JX (PU)
234	1.000	.00	57127.	29106.	.7	.00233 + J .02053

```
                BALANCED VOLTAGE DROP AND LOAD FLOW ANALYSIS
*****************************************************************************
VOLTAGE EFFECT ON LOADS MODELED
VOLTAGE DROP CRITERIA: BRANCH =  4.00 %   BUS =  5.00


==== BUS:    1 A8 BUS 1   DESIGN VOLTAGE: 13800  BUS VOLTAGE: 14604 %VD: -5.8
========================= PU BUS VOLTAGE:    1.06       ANGLE:  -6.9 DEGREES
                NET BRANCH DIVERSITY LOAD:  16400. KW   5390. KVAR

LOAD   TO:    5 C8X5         FEEDER AMPS:   254 VOLTAGE DROP:     0. %VD:    .0
PROJECTED POWER FLOW:  5956. KW  2429. KVAR  6433. KVA    PF:    .93   LAGGING
LOSSES THRU FEEDER:        0. KW        0. KVAR        0. KVA

LOAD   TO:   10 C8XNEW1      FEEDER AMPS:   255 VOLTAGE DROP:     0. %VD:    .0
PROJECTED POWER FLOW:  5971. KW  2411. KVAR  6440. KVA    PF:    .93   LAGGING
LOSSES THRU FEEDER:        0. KW        0. KVAR        0. KVA

LOAD FROM:  100 A2702C SEC   FEEDER AMPS:  1191 VOLTAGE DROP:     2. %VD:    .0
PROJECTED POWER FLOW: 28328. KW 10231. KVAR 30119. KVA    PF:    .94   LAGGING
LOSSES THRU FEEDER:        2. KW        8. KVAR        9. KVA


==== BUS:    2 A8 BUS 2   DESIGN VOLTAGE: 13800  BUS VOLTAGE: 14586 %VD: -5.7
========================= PU BUS VOLTAGE:    1.06       ANGLE:  -7.0 DEGREES
                NET BRANCH DIVERSITY LOAD:  16400. KW   5390. KVAR

LOAD   TO:    8 C8X8         FEEDER AMPS:   264 VOLTAGE DROP:     0. %VD:    .0
PROJECTED POWER FLOW:  6109. KW  2659. KVAR  6663. KVA    PF:    .92   LAGGING
LOSSES THRU FEEDER:        0. KW        0. KVAR        0. KVA

LOAD   TO:   20 C8XNEW2      FEEDER AMPS:   255 VOLTAGE DROP:     0. %VD:    .0
PROJECTED POWER FLOW:  5972. KW  2413. KVAR  6441. KVA    PF:    .93   LAGGING
LOSSES THRU FEEDER:        0. KW        0. KVAR        0. KVA

LOAD FROM:  200 A2703C SEC   FEEDER AMPS:  1201 VOLTAGE DROP:     2. %VD:    .0
PROJECTED POWER FLOW: 28482. KW 10462. KVAR 30342. KVA    PF:    .94   LAGGING
LOSSES THRU FEEDER:        2. KW        9. KVAR        9. KVA


==== BUS:    5 C8X5       DESIGN VOLTAGE: 13800  BUS VOLTAGE: 14604 %VD: -5.8
========================= PU BUS VOLTAGE:    1.06       ANGLE:  -6.9 DEGREES

LOAD FROM:    1 A8 BUS 1     FEEDER AMPS:   254 VOLTAGE DROP:     0. %VD:    .0
PROJECTED POWER FLOW:  5956. KW  2429. KVAR  6433. KVA    PF:    .93   LAGGING
LOSSES THRU FEEDER:        0. KW        0. KVAR        0. KVA
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                BALANCED VOLTAGE DROP AND LOAD FLOW ANALYSIS
*****************************************************************************
VOLTAGE EFFECT ON LOADS MODELED
VOLTAGE DROP CRITERIA: BRANCH =  4.00 %   BUS =  5.00


LOAD   TO: 5000 L5 RISER     FEEDER AMPS:   254 VOLTAGE DROP:    2. %VD:   .0
PROJECTED POWER FLOW:  5956. KW  2429. KVAR  6433. KVA    PF:   .93  LAGGING
LOSSES THRU FEEDER:        1. KW        1. KVAR        1. KVA


==== BUS:    8 C8X8        DESIGN VOLTAGE: 13800  BUS VOLTAGE: 14586 %VD: -5.7
======================== PU BUS VOLTAGE:    1.06        ANGLE:  -7.0 DEGREES

LOAD FROM:     2 A8 BUS 2     FEEDER AMPS:   264 VOLTAGE DROP:    0. %VD:   .0
PROJECTED POWER FLOW:  6109. KW  2659. KVAR  6663. KVA    PF:   .92  LAGGING
LOSSES THRU FEEDER:        0. KW        0. KVAR        0. KVA

LOAD   TO: 8000 L8 RISER     FEEDER AMPS:   264 VOLTAGE DROP:    4. %VD:   .0
PROJECTED POWER FLOW:  6109. KW  2659. KVAR  6663. KVA    PF:   .92  LAGGING
LOSSES THRU FEEDER:        1. KW        2. KVAR        2. KVA


==== BUS:   10 C8XNEW1     DESIGN VOLTAGE: 13800  BUS VOLTAGE: 14604 %VD: -5.8
======================== PU BUS VOLTAGE:    1.06        ANGLE:  -6.9 DEGREES

LOAD FROM:     1 A8 BUS 1     FEEDER AMPS:   255 VOLTAGE DROP:    0. %VD:   .0
PROJECTED POWER FLOW:  5971. KW  2411. KVAR  6440. KVA    PF:   .93  LAGGING
LOSSES THRU FEEDER:        0. KW        0. KVAR        0. KVA

LOAD   TO: 1000 NEW1 RISER   FEEDER AMPS:   255 VOLTAGE DROP:    4. %VD:   .0
PROJECTED POWER FLOW:  5971. KW  2411. KVAR  6440. KVA    PF:   .93  LAGGING
LOSSES THRU FEEDER:        1. KW        2. KVAR        2. KVA


==== BUS:   20 C8XNEW2     DESIGN VOLTAGE: 13800  BUS VOLTAGE: 14586 %VD: -5.7
======================== PU BUS VOLTAGE:    1.06        ANGLE:  -7.0 DEGREES

LOAD FROM:     2 A8 BUS 2     FEEDER AMPS:   255 VOLTAGE DROP:    0. %VD:   .0
PROJECTED POWER FLOW:  5972. KW  2413. KVAR  6441. KVA    PF:   .93  LAGGING
LOSSES THRU FEEDER:        0. KW        0. KVAR        0. KVA

LOAD   TO: 2000 NEW2 RISER   FEEDER AMPS:   255 VOLTAGE DROP:    4. %VD:   .0
PROJECTED POWER FLOW:  5972. KW  2413. KVAR  6441. KVA    PF:   .93  LAGGING
LOSSES THRU FEEDER:        1. KW        2. KVAR        2. KVA
```

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                 BALANCED VOLTAGE DROP AND LOAD FLOW ANALYSIS
******************************************************************************
VOLTAGE EFFECT ON LOADS MODELED
VOLTAGE DROP CRITERIA: BRANCH =  4.00 %   BUS =  5.00


==== BUS:  100 A2702C SEC DESIGN VOLTAGE: 13800  BUS VOLTAGE: 14606 %VD: -5.8
======================= PU BUS VOLTAGE:    1.06       ANGLE:  -6.9 DEGREES

LOAD   TO:     1 A8 BUS 1     FEEDER AMPS:  1191 VOLTAGE DROP:    2. %VD:   .0
PROJECTED POWER FLOW: 28330. KW 10240. KVAR 30123. KVA    PF:   .94   LAGGING
LOSSES THRU FEEDER:         2. KW       8. KVAR       9. KVA

LOAD FROM:  234 BPA           TRANSF AMPS:  1191 VOLTAGE DROP: -906. %VD: -6.6
PROJECTED POWER FLOW: 28330. KW 10240. KVAR 30123. KVA    PF:   .94   LAGGING
LOSSES THRU TRANSF:     110.5 KW 3735.2 KVAR 3736.8 KVA ***XFMR TAPS  -5.0%***

LOAD FROM: 9999 ZIGZAG #1     TRANSF AMPS:          VOLTAGE DROP:    0. %VD:   .0
PROJECTED POWER FLOW:      0. KW      0. KVAR     0. KVA    PF:   .00   LAGGING
LOSSES THRU TRANSF:        .0 KW      .0 KVAR     .0 KVA


==== BUS:  200 A2703C SEC DESIGN VOLTAGE: 13800  BUS VOLTAGE: 14588 %VD: -5.7
======================= PU BUS VOLTAGE:    1.06       ANGLE:  -7.0 DEGREES

LOAD   TO:     2 A8 BUS 2     FEEDER AMPS:  1201 VOLTAGE DROP:    2. %VD:   .0
PROJECTED POWER FLOW: 28483. KW 10471. KVAR 30347. KVA    PF:   .94   LAGGING
LOSSES THRU FEEDER:         2. KW       9. KVAR       9. KVA

LOAD FROM:  234 BPA           TRANSF AMPS:  1201 VOLTAGE DROP: -888. %VD: -6.4
PROJECTED POWER FLOW: 28483. KW 10471. KVAR 30347. KVA    PF:   .94   LAGGING
LOSSES THRU TRANSF:     108.3 KW 3816.9 KVAR 3818.4 KVA ***XFMR TAPS  -5.0%***

LOAD FROM: 8999 ZIGZAG #2     TRANSF AMPS:          VOLTAGE DROP:    0. %VD:   .0
PROJECTED POWER FLOW:      0. KW      0. KVAR     0. KVA    PF:   .00   LAGGING
LOSSES THRU TRANSF:        .0 KW      .0 KVAR     .0 KVA


==== BUS:  234 BPA            DESIGN VOLTAGE:234400  BUS VOLTAGE:232703 %VD:    .7
======================= PU BUS VOLTAGE:     .99       ANGLE:   -.6 DEGREES
            *** SWING  GENERATOR:     1     57127. KW    29106. KVAR

LOAD   TO:  100 A2702C SEC    TRANSF AMPS:    79 VOLTAGE DROP:****** %VD: -6.6
PROJECTED POWER FLOW: 28440. KW 13975. KVAR 31688. KVA    PF:   .90   LAGGING
LOSSES THRU TRANSF:     110.5 KW 3735.2 KVAR 3736.8 KVA ***XFMR TAPS  -5.0%***

LOAD   TO:  200 A2703C SEC    TRANSF AMPS:    79 VOLTAGE DROP:****** %VD: -6.4
PROJECTED POWER FLOW: 28592. KW 14288. KVAR 31963. KVA    PF:   .89   LAGGING
LOSSES THRU TRANSF:     108.3 KW 3816.9 KVAR 3818.4 KVA ***XFMR TAPS  -5.0%***
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                 BALANCED VOLTAGE DROP AND LOAD FLOW ANALYSIS
******************************************************************************
VOLTAGE EFFECT ON LOADS MODELED
VOLTAGE DROP CRITERIA: BRANCH =  4.00 %   BUS =  5.00


LOAD FROM: **** SOURCE INT   FEEDER AMPS:   158 VOLTAGE DROP: 1697. %VD:   .7
PROJECTED POWER FLOW: 57032. KW 28263. KVAR 63651. KVA    PF:   .90  LAGGING
LOSSES THRU FEEDER:       96. KW     844. KVAR    849. KVA


==== BUS: 1000 NEW1 RISER DESIGN VOLTAGE: 13800  BUS VOLTAGE: 14600 %VD: -5.8
========================= PU BUS VOLTAGE:   1.06       ANGLE:  -7.0 DEGREES

LOAD FROM:   10 C8XNEW1      FEEDER AMPS:   255 VOLTAGE DROP:    4. %VD:   .0
PROJECTED POWER FLOW:  5970. KW  2409. KVAR  6438. KVA    PF:   .93  LAGGING
LOSSES THRU FEEDER:        1. KW       2. KVAR      2. KVA

LOAD   TO: 1800 8TH STREET   FEEDER AMPS:   255 VOLTAGE DROP:  882. %VD:  6.4$
PROJECTED POWER FLOW:  5970. KW  2409. KVAR  6438. KVA    PF:   .93  LAGGING
LOSSES THRU FEEDER:      239. KW     474. KVAR    531. KVA


==== BUS: 1800 8TH STREET DESIGN VOLTAGE: 13800  BUS VOLTAGE: 13718 %VD:   .6
========================= PU BUS VOLTAGE:    .99       ANGLE: -10.3 DEGREES

LOAD FROM: 1000 NEW1 RISER   FEEDER AMPS:   255 VOLTAGE DROP:  882. %VD:  6.4$
PROJECTED POWER FLOW:  5731. KW  1935. KVAR  6049. KVA    PF:   .95  LAGGING
LOSSES THRU FEEDER:      239. KW     474. KVAR    531. KVA

LOAD   TO: 1900 TWRS #2      FEEDER AMPS:   255 VOLTAGE DROP:  111. %VD:   .8
PROJECTED POWER FLOW:  5731. KW  1935. KVAR  6049. KVA    PF:   .95  LAGGING
LOSSES THRU FEEDER:       31. KW      62. KVAR     69. KVA


==== BUS: 1900 TWRS #2    DESIGN VOLTAGE: 13800  BUS VOLTAGE: 13606 %VD:  1.4
========================= PU BUS VOLTAGE:    .99       ANGLE: -10.7 DEGREES
               NET BRANCH DIVERSITY LOAD:   5700. KW   1873. KVAR

LOAD FROM: 1800 8TH STREET   FEEDER AMPS:   255 VOLTAGE DROP:  111. %VD:   .8
PROJECTED POWER FLOW:  5700. KW  1874. KVAR  6000. KVA    PF:   .95  LAGGING
LOSSES THRU FEEDER:       31. KW      62. KVAR     69. KVA
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                BALANCED VOLTAGE DROP AND LOAD FLOW ANALYSIS
*****************************************************************************
VOLTAGE EFFECT ON LOADS MODELED
VOLTAGE DROP CRITERIA: BRANCH =  4.00 %   BUS =  5.00


==== BUS: 2000 NEW2 RISER DESIGN VOLTAGE: 13800  BUS VOLTAGE: 14582 %VD: -5.7
======================== PU BUS VOLTAGE:   1.06        ANGLE:  -7.0 DEGREES

LOAD FROM:   20 C8XNEW2      FEEDER AMPS:   255 VOLTAGE DROP:    4. %VD:   .0
PROJECTED POWER FLOW:  5971. KW  2411. KVAR  6439. KVA    PF:   .93  LAGGING
LOSSES THRU FEEDER:        1. KW        2. KVAR       2. KVA

LOAD   TO: 2800 8TH STREET   FEEDER AMPS:   255 VOLTAGE DROP:  884. %VD:  6.4$
PROJECTED POWER FLOW:  5971. KW  2411. KVAR  6439. KVA    PF:   .93  LAGGING
LOSSES THRU FEEDER:      240. KW      475. KVAR     532. KVA


==== BUS: 2800 8TH STREET DESIGN VOLTAGE: 13800  BUS VOLTAGE: 13698 %VD:   .7
======================== PU BUS VOLTAGE:    .99        ANGLE: -10.4 DEGREES

LOAD FROM: 2000 NEW2 RISER   FEEDER AMPS:   255 VOLTAGE DROP:  884. %VD:  6.4$
PROJECTED POWER FLOW:  5731. KW  1935. KVAR  6049. KVA    PF:   .95  LAGGING
LOSSES THRU FEEDER:      240. KW      475. KVAR     532. KVA

LOAD   TO: 2900 TWRS #1      FEEDER AMPS:   255 VOLTAGE DROP:  111. %VD:   .8
PROJECTED POWER FLOW:  5731. KW  1935. KVAR  6049. KVA    PF:   .95  LAGGING
LOSSES THRU FEEDER:       31. KW       62. KVAR      69. KVA


==== BUS: 2900 TWRS #1    DESIGN VOLTAGE: 13800  BUS VOLTAGE: 13587 %VD:  1.5
======================== PU BUS VOLTAGE:    .98        ANGLE: -10.8 DEGREES
               NET BRANCH DIVERSITY LOAD:   5700. KW   1873. KVAR

LOAD FROM: 2800 8TH STREET   FEEDER AMPS:   255 VOLTAGE DROP:  111. %VD:   .8
PROJECTED POWER FLOW:  5700. KW  1874. KVAR  6000. KVA    PF:   .95  LAGGING
LOSSES THRU FEEDER:       31. KW       62. KVAR      69. KVA


==== BUS: 5000 L5 RISER   DESIGN VOLTAGE: 13800  BUS VOLTAGE: 14602 %VD: -5.8
======================== PU BUS VOLTAGE:   1.06        ANGLE:  -7.0 DEGREES

LOAD FROM:    5 C8X5         FEEDER AMPS:   254 VOLTAGE DROP:    2. %VD:   .0
PROJECTED POWER FLOW:  5956. KW  2428. KVAR  6432. KVA    PF:   .93  LAGGING
LOSSES THRU FEEDER:        1. KW        1. KVAR       1. KVA

LOAD   TO: 5200 C8X110       FEEDER AMPS:   254 VOLTAGE DROP:  674. %VD:  4.9$
PROJECTED POWER FLOW:  5956. KW  2428. KVAR  6432. KVA    PF:   .93  LAGGING
LOSSES THRU FEEDER:      173. KW      380. KVAR     417. KVA
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                BALANCED VOLTAGE DROP AND LOAD FLOW ANALYSIS
******************************************************************************
VOLTAGE EFFECT ON LOADS MODELED
VOLTAGE DROP CRITERIA: BRANCH =  4.00 %   BUS =  5.00


==== BUS: 5200 C8X110      DESIGN VOLTAGE: 13800  BUS VOLTAGE: 13928 %VD:  -.9
======================== PU BUS VOLTAGE:   1.01        ANGLE:  -9.6 DEGREES

LOAD FROM: 5000 L5 RISER      FEEDER AMPS:   254 VOLTAGE DROP:  674. %VD:  4.9$
PROJECTED POWER FLOW:  5783. KW  2049. KVAR  6135. KVA    PF:   .94   LAGGING
LOSSES THRU FEEDER:     173. KW     380. KVAR     417. KVA

LOAD   TO: 5800 8TH STREET   FEEDER AMPS:   254 VOLTAGE DROP:  196. %VD:  1.4
PROJECTED POWER FLOW:  5783. KW  2049. KVAR  6135. KVA    PF:   .94   LAGGING
LOSSES THRU FEEDER:      52. KW     114. KVAR     125. KVA


==== BUS: 5800 8TH STREET DESIGN VOLTAGE: 13800  BUS VOLTAGE: 13733 %VD:   .5
======================== PU BUS VOLTAGE:   1.00        ANGLE: -10.5 DEGREES

LOAD FROM: 5200 C8X110       FEEDER AMPS:   254 VOLTAGE DROP:  196. %VD:  1.4
PROJECTED POWER FLOW:  5731. KW  1935. KVAR  6049. KVA    PF:   .95   LAGGING
LOSSES THRU FEEDER:      52. KW     114. KVAR     125. KVA

LOAD   TO: 5900 TWRS #1      FEEDER AMPS:   254 VOLTAGE DROP:  111. %VD:   .8
PROJECTED POWER FLOW:  5731. KW  1935. KVAR  6049. KVA    PF:   .95   LAGGING
LOSSES THRU FEEDER:      31. KW      62. KVAR      69. KVA


==== BUS: 5900 TWRS #1     DESIGN VOLTAGE: 13800  BUS VOLTAGE: 13622 %VD:  1.3
======================== PU BUS VOLTAGE:    .99        ANGLE: -10.9 DEGREES
              NET BRANCH DIVERSITY LOAD:   5700. KW   1873. KVAR

LOAD FROM: 5800 8TH STREET   FEEDER AMPS:   254 VOLTAGE DROP:  111. %VD:   .8
PROJECTED POWER FLOW:  5700. KW  1874. KVAR  6000. KVA    PF:   .95   LAGGING
LOSSES THRU FEEDER:      31. KW      62. KVAR      69. KVA


==== BUS: 8000 L8 RISER    DESIGN VOLTAGE: 13800  BUS VOLTAGE: 14581 %VD: -5.7
======================== PU BUS VOLTAGE:   1.06        ANGLE:  -7.0 DEGREES

LOAD FROM:     8 C8X8        FEEDER AMPS:   264 VOLTAGE DROP:    4. %VD:   .0
PROJECTED POWER FLOW:  6108. KW  2657. KVAR  6661. KVA    PF:   .92   LAGGING
LOSSES THRU FEEDER:       1. KW       2. KVAR       2. KVA

LOAD   TO: 8200 C8X294       FEEDER AMPS:   264 VOLTAGE DROP: 1033. %VD:  7.5$
PROJECTED POWER FLOW:  6108. KW  2657. KVAR  6661. KVA    PF:   .92   LAGGING
LOSSES THRU FEEDER:     290. KW     547. KVAR     619. KVA
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                BALANCED VOLTAGE DROP AND LOAD FLOW ANALYSIS
*****************************************************************************
VOLTAGE EFFECT ON LOADS MODELED
VOLTAGE DROP CRITERIA: BRANCH =  4.00 %   BUS =  5.00


==== BUS: 8200 C8X294      DESIGN VOLTAGE: 13800  BUS VOLTAGE: 13549 %VD:  1.8
======================== PU BUS VOLTAGE:     .98        ANGLE: -10.6 DEGREES

LOAD FROM: 8000 L8 RISER     FEEDER AMPS:   264 VOLTAGE DROP: 1033. %VD:  7.5$
PROJECTED POWER FLOW:  5818. KW  2110. KVAR  6189. KVA    PF:   .94   LAGGING
LOSSES THRU FEEDER:     290. KW    547. KVAR    619. KVA

LOAD   TO: 8700 EXT #1       FEEDER AMPS:   264 VOLTAGE DROP:  199. %VD:  1.4
PROJECTED POWER FLOW:  5818. KW  2110. KVAR  6189. KVA    PF:   .94   LAGGING
LOSSES THRU FEEDER:      57. KW    111. KVAR    125. KVA


==== BUS: 8700 EXT #1      DESIGN VOLTAGE: 13800  BUS VOLTAGE: 13349 %VD:  3.3
======================== PU BUS VOLTAGE:     .97        ANGLE: -11.4 DEGREES

LOAD FROM: 8200 C8X294       FEEDER AMPS:   264 VOLTAGE DROP:  199. %VD:  1.4
PROJECTED POWER FLOW:  5761. KW  2000. KVAR  6098. KVA    PF:   .94   LAGGING
LOSSES THRU FEEDER:      57. KW    111. KVAR    125. KVA

LOAD   TO: 8750 OLD C8L5     FEEDER AMPS:   264 VOLTAGE DROP:   13. %VD:   .1
PROJECTED POWER FLOW:  5761. KW  2000. KVAR  6098. KVA    PF:   .94   LAGGING
LOSSES THRU FEEDER:       4. KW      8. KVAR      8. KVA


==== BUS: 8750 OLD C8L5    DESIGN VOLTAGE: 13800  BUS VOLTAGE: 13336 %VD:  3.4
======================== PU BUS VOLTAGE:     .97        ANGLE: -11.5 DEGREES

LOAD FROM: 8700 EXT #1       FEEDER AMPS:   264 VOLTAGE DROP:   13. %VD:   .1
PROJECTED POWER FLOW:  5757. KW  1992. KVAR  6092. KVA    PF:   .95   LAGGING
LOSSES THRU FEEDER:       4. KW      8. KVAR      8. KVA

LOAD   TO: 8800 8TH STREET   FEEDER AMPS:   264 VOLTAGE DROP:   86. %VD:   .6
PROJECTED POWER FLOW:  5757. KW  1992. KVAR  6092. KVA    PF:   .95   LAGGING
LOSSES THRU FEEDER:      24. KW     52. KVAR     57. KVA


==== BUS: 8800 8TH STREET DESIGN VOLTAGE: 13800  BUS VOLTAGE: 13250 %VD:  4.0
======================== PU BUS VOLTAGE:     .96        ANGLE: -11.8 DEGREES

LOAD FROM: 8750 OLD C8L5     FEEDER AMPS:   264 VOLTAGE DROP:   86. %VD:   .6
PROJECTED POWER FLOW:  5733. KW  1940. KVAR  6053. KVA    PF:   .95   LAGGING
LOSSES THRU FEEDER:      24. KW     52. KVAR     57. KVA
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                BALANCED VOLTAGE DROP AND LOAD FLOW ANALYSIS
*****************************************************************************
VOLTAGE EFFECT ON LOADS MODELED
VOLTAGE DROP CRITERIA: BRANCH =  4.00 %   BUS =  5.00


LOAD   TO: 8900 TWRS #2      FEEDER AMPS:   264 VOLTAGE DROP:  115. %VD:   .8
PROJECTED POWER FLOW:  5733. KW  1940. KVAR  6053. KVA    PF:   .95  LAGGING
LOSSES THRU FEEDER:      33. KW      66. KVAR      74. KVA


==== BUS: 8900 TWRS #2    DESIGN VOLTAGE: 13800  BUS VOLTAGE: 13135 %VD:  4.8
========================= PU BUS VOLTAGE:    .95       ANGLE: -12.3 DEGREES
               NET BRANCH DIVERSITY LOAD:   5700. KW   1873. KVAR

LOAD FROM: 8800 8TH STREET   FEEDER AMPS:   264 VOLTAGE DROP:  115. %VD:   .8
PROJECTED POWER FLOW:  5700. KW  1874. KVAR  6000. KVA    PF:   .95  LAGGING
LOSSES THRU FEEDER:      33. KW      66. KVAR      74. KVA


==== BUS: 8999 ZIGZAG #2  DESIGN VOLTAGE: 13800  BUS VOLTAGE: 14588 %VD: -5.7
========================= PU BUS VOLTAGE:   1.06       ANGLE:  -7.0 DEGREES
**** NO LOAD SPECIFIED ****


==== BUS: 9999 ZIGZAG #1  DESIGN VOLTAGE: 13800  BUS VOLTAGE: 14606 %VD: -5.8
========================= PU BUS VOLTAGE:   1.06       ANGLE:  -6.9 DEGREES
**** NO LOAD SPECIFIED ****
```

BALANCED VOLTAGE DROP AND LOAD FLOW BUS DATA SUMMARY

BUS#	NAME	BASE VOLT	PU VOLT	BUS#	NAME	BASE VOLT	PU VOLT
1	A8 BUS 1	13800.00	1.0583	2	A8 BUS 2	13800.00	1.0570
5	C8X5	13800.00	1.0583	8	C8X8	13800.00	1.0569
10	C8XNEW1	13800.00	1.0583	20	C8XNEW2	13800.00	1.0569
100	A2702C SEC	13800.00	1.0584	200	A2703C SEC	13800.00	1.0571
234	BPA	234400.00	.9928	1000	NEW1 RISER	13800.00	1.0580
1800	8TH STREET	13800.00	.9940	1900	TWRS #2	13800.00	.9860
2000	NEW2 RISER	13800.00	1.0566	2800	8TH STREET	13800.00	.9926
2900	TWRS #1	13800.00	.9845	5000	L5 RISER	13800.00	1.0581
5200	C8X110	13800.00	1.0093	5800	8TH STREET	13800.00	.9951
5900	TWRS #1	13800.00	.9871	8000	L8 RISER	13800.00	1.0566
8200	C8X294	13800.00	.9818	8700	EXT #1	13800.00	.9674
8750	OLD C8L5	13800.00	.9664	8800	8TH STREET	13800.00	.9601
8900	TWRS #2	13800.00	.9518	8999	ZIGZAG #2	13800.00	1.0571

BALANCED VOLTAGE DROP AND LOAD FLOW BRANCH DATA SUMMARY

FROM	NAME	TO	NAME	TYPE	VD%	AMPS	KVA	RATING%
1	A8 BUS 1	5	C8X5	FDR	.00	254.31	6432.75	42.39
1	A8 BUS 1	10	C8XNEW1	FDR	.00	254.59	6439.89	42.43
1	A8 BUS 1	100	A2702C SEC	FDR	.02	1190.71	30118.80	56.70
2	A8 BUS 2	8	C8X8	FDR	.00	263.74	6662.93	43.96
2	A8 BUS 2	20	C8XNEW2	FDR	.00	254.96	6441.24	42.49
2	A8 BUS 2	200	A2703C SEC	FDR	.02	1201.03	30342.41	57.19
5	C8X5	1	A8 BUS 1	FDR	.00	254.31	6432.74	42.39
5	C8X5	5000	L5 RISER	FDR	.02	254.31	6432.74	47.09
8	C8X8	2	A8 BUS 2	FDR	.00	263.74	6662.92	43.96
8	C8X8	8000	L8 RISER	FDR	.03	263.74	6662.92	43.96
10	C8XNEW1	1	A8 BUS 1	FDR	.00	254.59	6439.88	42.43
10	C8XNEW1	1000	NEW1 RISER	FDR	.03	254.59	6439.88	42.43
20	C8XNEW2	2	A8 BUS 2	FDR	.00	254.96	6441.23	42.49
20	C8XNEW2	2000	NEW2 RISER	FDR	.03	254.96	6441.23	42.49
100	A2702C SEC	1	A8 BUS 1	FDR	.02	1190.71	30123.30	56.70
100	A2702C SEC	234	BPA	TX2	-6.57	1190.71	30123.30	60.25
100	A2702C SEC	9999	ZIGZAG #1	TX2	.00	.00	.00	.00
200	A2703C SEC	2	A8 BUS 2	FDR	.02	1201.03	30347.03	57.19
200	A2703C SEC	234	BPA	TX2	-6.44	1201.03	30347.03	60.69
200	A2703C SEC	8999	ZIGZAG #2	TX2	.00	.00	.00	.00
234	BPA	100	A2702C SEC	TX2	-6.57	78.62	31688.04	63.38
234	BPA	200	A2703C SEC	TX2	-6.44	79.30	31962.82	63.93
1000	NEW1 RISER	10	C8XNEW1	FDR	.03	254.59	6438.02	42.43

BALANCED VOLTAGE DROP AND LOAD FLOW BRANCH DATA SUMMARY

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FROM	NAME	TO	NAME	TYPE	VD%	AMPS	KVA	RATING%
1000	NEW1 RISER	1800	8TH STREET	FDR	6.39	254.59	6438.02	42.43
1800	8TH STREET	1000	NEW1 RISER	FDR	6.39	254.59	6049.04	42.43
1800	8TH STREET	1900	TWRS #2	FDR	.81	254.59	6049.04	42.43
1900	TWRS #2	1800	8TH STREET	FDR	.81	254.59	6000.01	42.43
2000	NEW2 RISER	20	C8XNEW2	FDR	.03	254.96	6439.37	42.49
2000	NEW2 RISER	2800	8TH STREET	FDR	6.40	254.96	6439.37	42.49
2800	8TH STREET	2000	NEW2 RISER	FDR	6.40	254.96	6049.15	42.49
2800	8TH STREET	2900	TWRS #1	FDR	.81	254.96	6049.15	42.49
2900	TWRS #1	2800	8TH STREET	FDR	.81	254.96	5999.98	42.49
5000	L5 RISER	5	C8X5	FDR	.02	254.31	6431.76	47.09
5000	L5 RISER	5200	C8X110	FDR	4.88	254.31	6431.76	42.39
5200	C8X110	5000	L5 RISER	FDR	4.88	254.31	6135.06	42.39
5200	C8X110	5800	8TH STREET	FDR	1.42	254.31	6135.06	42.39
5800	8TH STREET	5200	C8X110	FDR	1.42	254.31	6048.94	42.39
5800	8TH STREET	5900	TWRS #1	FDR	.80	254.31	6048.94	42.39
5900	TWRS #1	5800	8TH STREET	FDR	.80	254.31	6000.01	42.39
8000	L8 RISER	8	C8X8	FDR	.03	263.74	6660.88	43.96
8000	L8 RISER	8200	C8X294	FDR	7.48	263.74	6660.88	43.96
8200	C8X294	8000	L8 RISER	FDR	7.48	263.74	6189.09	43.96
8200	C8X294	8700	EXT #1	FDR	1.44	263.74	6189.09	43.96
8700	EXT #1	8200	C8X294	FDR	1.44	263.74	6098.12	43.96
8700	EXT #1	8750	OLD C8L5	FDR	.10	263.74	6098.12	43.96
8750	OLD C8L5	8700	EXT #1	FDR	.10	263.74	6092.04	43.96
8750	OLD C8L5	8800	8TH STREET	FDR	.63	263.74	6092.04	43.96
8800	8TH STREET	8750	OLD C8L5	FDR	.63	263.74	6052.59	43.96
8800	8TH STREET	8900	TWRS #2	FDR	.83	263.74	6052.59	43.96
8900	TWRS #2	8800	8TH STREET	FDR	.83	263.74	5999.96	43.96
8999	ZIGZAG #2	200	A2703C SEC	TX2	.00	.00	.00	.00
9999	ZIGZAG #1	100	A2702C SEC	TX2	.00	.00	.00	.00

NOTE: FOR FEEDERS, RATING% = LOAD FLOW AMPS / FLA.
FLA = LIBRARY FLA EXCLUDING DUCT BANK AND TEMP. DERATING FOR CABLES.
FLA = BRANCH RECORD INPUT FLA FOR IMPEDANCE DATA.

NOTE: FOR TRANSFORMERS, RATING% = LOAD FLOW KVA / TRANSFORMER FULL LOAD KVA.

27 BUSES

*** T O T A L   S Y S T E M   L O S S E S ***
1527. KW   10831. KVAR

WARNING STUDY CONTAINS 8 VOLTAGE CRITERIA VIOLATIONS
VIOLATIONS DENOTED BY ($) AT BUS AND BRANCH %VD LOCATIONS

BASIC CASE 1 MODEL

Primary transformer modeled at 220 kV primary volts with tap of -5 percent. The fault contribution at substation A8 has been modeled at 234.4 kV. 234.4 kV is the regulatory requirement BPA must meet at the WNP #2 start-up transformers (at Ashe Substation). Substation A8 was modeled with 17.3 MVA at -0.95 power factor on each A8 bus (this is the forecasted load for all non-TWRS Phase I facilities for FY 2003). The Case 1 model uses two new express feeders from substation A8 following the line C8L5 corridor using 336 ACSR aerial conductors. Lines C8L5 and C8L8 were modeled as express feeders to the Phase I TWRS privatization site.

Case 1c - each express feeder was loaded with 7.5 MVA at -0.95 power factor at the Phase I TWRS site.

Study performed by ICF Kaiser Hanford, Utilities Engineering and Technical Services
Richland, Washington

DATE: 6 FEB 96
TIME: 8 03 AM
FILE: LFC1C.R0

ALL INFORMATION PRESENTED IS FOR REVIEW, APPROVAL
INTERPRETATION AND APPLICATION BY A REGISTERED
ENGINEER ONLY

DAPPER (LOAD FLOW AND VOLTAGE DROP MINI/MICRO VERSION 4.5 LEVEL 1.0)

```
          SWING GENERATORS
    BUS NO     ID STAT VOLTAGE  ANGLE
    ================================
       234      1  1    1.00      .00
NOTICE: BRANCH    -1 A8 SUB      TO  230 A8 SUB     IS OUT OF SERVICE
NOTICE: BRANCH  230 A8 SUB      TO  100 A2702C SEC IS OUT OF SERVICE
NOTICE: BRANCH  230 A8 SUB      TO  200 A2703C SEC IS OUT OF SERVICE
```

F E E D E R   D A T A

FEEDER FROM NO	NAME	FEEDER TO NO	NAME	QTY /PH	VOLTS L-L	LENGTH	FEEDER SIZE	TYPE	DESCRIPTION DUCT	INSUL
1	A8 BUS 1	5	C8X5	1	13800.	1. M				
	IMPEDANCE:	.0230 + J .1115 OHMS/M METERS								
1	A8 BUS 1	10	C8XNEW1	1	13800.	1. M				
	IMPEDANCE:	.0230 + J .1115 OHMS/M METERS								
2	A8 BUS 2	8	C8X8	1	13800.	1. M				
	IMPEDANCE:	.0230 + J .1115 OHMS/M METERS								
2	A8 BUS 2	20	C8XNEW2	1	13800.	1. M				
	IMPEDANCE:	.0230 + J .1115 OHMS/M METERS								
5	C8X5	5000	L5 RISER	1	13800.	46. M				
	IMPEDANCE:	.0709 + J .1174 OHMS/M METERS								
8	C8X8	8000	L8 RISER	1	13800.	87. M				
	IMPEDANCE:	.0709 + J .1174 OHMS/M METERS								
10	C8XNEW1	1000	NEW1 RISER	1	13800.	87. M				
	IMPEDANCE:	.0709 + J .1174 OHMS/M METERS								
20	C8XNEW2	2000	NEW2 RISER	1	13800.	87. M				
	IMPEDANCE:	.0709 + J .1174 OHMS/M METERS								
100	A2702C SEC	1	A8 BUS 1	3	13800.	53. M				
	IMPEDANCE:	.0230 + J .1115 OHMS/M METERS								
200	A2703C SEC	2	A8 BUS 2	3	13800.	53. M				
	IMPEDANCE:	.0230 + J .1116 OHMS/M METERS								
1000	NEW1 RISER	1800	8TH STREET	1	13800.	6148. M				
	IMPEDANCE:	.2000 + J .3965 OHMS/M METERS								
1800	8TH STREET	1900	TWRS #2	1	13800.	800. M				
	IMPEDANCE:	.2001 + J .3965 OHMS/M METERS								
2000	NEW2 RISER	2800	8TH STREET	1	13800.	6148. M				
	IMPEDANCE:	.2001 + J .3965 OHMS/M METERS								
2800	8TH STREET	2900	TWRS #1	1	13800.	800. M				
	IMPEDANCE:	.2001 + J .3965 OHMS/M METERS								
5000	L5 RISER	5200	C8X110	1	13800.	4731. M				
	IMPEDANCE:	.1883 + J .4135 OHMS/M METERS								

F E E D E R   D A T A

FEEDER NO	FROM NAME	FEEDER NO	TO NAME	QTY /PH	VOLTS L-L	LENGTH	FEEDER SIZE	TYPE	DESCRIPTION DUCT	INSUL
5200	C8X110	5800	8TH STREET	1	13800.	1417. M				
	IMPEDANCE: .1884 + J .4136 OHMS/M METERS									
5800	8TH STREET	5900	TWRS #1	1	13800.	800. M				
	IMPEDANCE: .2001 + J .3965 OHMS/M METERS									
8000	L8 RISER	8200	C8X294	1	13800.	6942. M				
	IMPEDANCE: .2001 + J .3774 OHMS/M METERS									
8200	C8X294	8700	EXT #1	1	13800.	1372. M				
	IMPEDANCE: .2000 + J .3865 OHMS/M METERS									
8700	EXT #1	8750	OLD C8L5	1	13800.	91. M				
	IMPEDANCE: .2007 + J .3982 OHMS/M METERS									
8750	OLD C8L5	8800	8TH STREET	1	13800.	606. M				
	IMPEDANCE: .1883 + J .4134 OHMS/M METERS									
8800	8TH STREET	8900	TWRS #2	1	13800.	800. M				
	IMPEDANCE: .2001 + J .3965 OHMS/M METERS									

SOURCE BUS THEVENIN EQUIVALENT IMPEDANCE: 1.278144000 + J11.277260000 OHMS
Calculated From Utility Contribution at Bus No. 234

T R A N S F O R M E R   D A T A

PRIMARY RECORD NO	NAME	VOLTS L-L	PRI FLA	* SECONDARY RECORD NO	NAME	VOLTS L-L	SEC FLA	NOMINAL KVA
234	BPA	220000.	79.	100	A2702C SEC	13800.	1255.	30000.0
	IMPEDANCE:	.4092 + J13.8340 PERCENT			TRANSFORMER FIXED TAP:			-5.0 %
234	BPA	220000.	79.	200	A2703C SEC	13800.	1255.	30000.0
	IMPEDANCE:	.3941 + J13.8944 PERCENT			TRANSFORMER FIXED TAP:			-5.0 %
8999	ZIGZAG #2	13800.	69.	200	A2703C SEC	13800.	69.	1657.0
	IMPEDANCE:	.4000 + J 3.1067 PERCENT						
9999	ZIGZAG #1	13800.	69.	100	A2702C SEC	13800.	69.	1657.0
	IMPEDANCE:	.4000 + J 3.1067 PERCENT						

B R A N C H   L O A D   D A T A

FROM / TO BUS / BUS	BR. TYPE	CONSTANT KVA KVA	%PF	CONSTANT Z KVA	%PF	CONSTANT I KVA	%PF	FLOW DIR.
1 A8 BUS 1								
5 C8X5	FEEDER	7500	-95.0					
10 C8XNEW1	FEEDER	7500	-95.0					
2 A8 BUS 2								
8 C8X8	FEEDER	7500	-95.0					
20 C8XNEW2	FEEDER	7500	-95.0					
5 C8X5								
5000 L5 RISER	FEEDER	7500	-95.0					
8 C8X8								
8000 L8 RISER	FEEDER	7500	-95.0					
10 C8XNEW1								
1000 NEW1 RISER	FEEDER	7500	-95.0					
20 C8XNEW2								
2000 NEW2 RISER	FEEDER	7500	-95.0					
100 A2702C SEC								
1 A8 BUS 1	FEEDER	32263	-95.0					
200 A2703C SEC								
2 A8 BUS 2	FEEDER	32263	-95.0					
1000 NEW1 RISER								
1800 8TH STREET	FEEDER	7500	-95.0					
1800 8TH STREET								
1900 TWRS #2	FEEDER	7500	-95.0					
2000 NEW2 RISER								
2800 8TH STREET	FEEDER	7500	-95.0					
2800 8TH STREET								
2900 TWRS #1	FEEDER	7500	-95.0					
5000 L5 RISER								
5200 C8X110	FEEDER	7500	-95.0					
5200 C8X110								
5800 8TH STREET	FEEDER	7500	-95.0					

BRANCH LOAD DATA

FROM BUS / TO BUS	BR. TYPE	CONSTANT KVA KVA	CONSTANT KVA %PF	CONSTANT Z KVA	CONSTANT Z %PF	CONSTANT I KVA	CONSTANT I %PF	FLOW DIR.
5800 8TH STREET								
5900 TWRS #1	FEEDER	7500	-95.0					
8000 L8 RISER								
8200 C8X294	FEEDER	7500	-95.0					
8200 C8X294								
8700 EXT #1	FEEDER	7500	-95.0					
8700 EXT #1								
8750 OLD C8L5	FEEDER	7500	-95.0					
8750 OLD C8L5								
8800 8TH STREET	FEEDER	7500	-95.0					
8800 8TH STREET								
8900 TWRS #2	FEEDER	7500	-95.0					
234 BPA								
100 A2702C	SEC TRANS.	32263	-95.0					
200 A2703C	SEC TRANS.	32263	-95.0					

```
*** SOLUTION COMMENTS ***
=========================

SOLUTION PARAMETERS

BRANCH VOLTAGE CRITERIA                         :   4.00 %
BUS VOLTAGE CRITERIA                            :   5.00 %
ACCELERATION FACTOR FOR 'PV' GENERATORS         :   1.00
ACCELERATION FACTOR FOR CONSTANT KVA LOADS:         1.00
EXACT(ITERATIVE) SOLUTION                       :   YES

<<PERCENT VOLTAGE DROPS ARE BASED ON NOMINAL DESIGN VOLTAGES>>

TOF SIZE:   82

LARGEST LOAD:           17263.20 KVA
CONVERGENCE CRITERIA:       .863 KVA
LARGEST BUS MISMATCH     1  A8 BUS 1         1663.628 KVA
LARGEST BUS MISMATCH  8900  TWRS #2           201.775 KVA
LARGEST BUS MISMATCH  8900  TWRS #2            52.377 KVA
LARGEST BUS MISMATCH  8900  TWRS #2            14.856 KVA
LARGEST BUS MISMATCH  8900  TWRS #2             4.284 KVA
LARGEST BUS MISMATCH  8900  TWRS #2             1.249 KVA
LARGEST BUS MISMATCH  8900  TWRS #2              .365 KVA
```

BALANCED VOLTAGE DROP AND LOAD FLOW ANALYSIS (SWING GENERATORS)

****

BUS	VOLTS(PU)	ANGLE	KW	KVAR	VD%	R + JX (PU)
234	1.000	.00	63761.	35089.	.9	.00233 + J .02053

```
                  BALANCED VOLTAGE DROP AND LOAD FLOW ANALYSIS
******************************************************************************
VOLTAGE EFFECT ON LOADS MODELED
VOLTAGE DROP CRITERIA: BRANCH =  4.00 %   BUS =  5.00


==== BUS:    1 A8 BUS 1   DESIGN VOLTAGE: 13800  BUS VOLTAGE: 14442 %VD: -4.7
========================= PU BUS VOLTAGE:   1.05       ANGLE:  -7.8 DEGREES
               NET BRANCH DIVERSITY LOAD:  16400. KW   5390. KVAR

LOAD   TO:    5 C8X5          FEEDER AMPS:   329 VOLTAGE DROP:    0. %VD:   .0
PROJECTED POWER FLOW:  7554. KW  3273. KVAR  8233. KVA   PF:   .92  LAGGING
LOSSES THRU FEEDER:        0. KW        0. KVAR        0. KVA

LOAD   TO:   10 C8XNEW1       FEEDER AMPS:   330 VOLTAGE DROP:    0. %VD:   .0
PROJECTED POWER FLOW:  7580. KW  3243. KVAR  8244. KVA   PF:   .92  LAGGING
LOSSES THRU FEEDER:        0. KW        0. KVAR        0. KVA

LOAD FROM:  100 A2702C SEC    FEEDER AMPS:  1347 VOLTAGE DROP:    3. %VD:   .0
PROJECTED POWER FLOW: 31534. KW 11906. KVAR 33707. KVA   PF:   .94  LAGGING
LOSSES THRU FEEDER:        2. KW       11. KVAR       11. KVA


==== BUS:    2 A8 BUS 2   DESIGN VOLTAGE: 13800  BUS VOLTAGE: 14408 %VD: -4.4
========================= PU BUS VOLTAGE:   1.04       ANGLE:  -7.9 DEGREES
               NET BRANCH DIVERSITY LOAD:  16400. KW   5390. KVAR

LOAD   TO:    8 C8X8          FEEDER AMPS:   347 VOLTAGE DROP:    0. %VD:   .0
PROJECTED POWER FLOW:  7835. KW  3703. KVAR  8666. KVA   PF:   .90  LAGGING
LOSSES THRU FEEDER:        0. KW        0. KVAR        0. KVA

LOAD   TO:   20 C8XNEW2       FEEDER AMPS:   331 VOLTAGE DROP:    0. %VD:   .0
PROJECTED POWER FLOW:  7583. KW  3248. KVAR  8249. KVA   PF:   .92  LAGGING
LOSSES THRU FEEDER:        0. KW        0. KVAR        0. KVA

LOAD FROM:  200 A2703C SEC    FEEDER AMPS:  1367 VOLTAGE DROP:    3. %VD:   .0
PROJECTED POWER FLOW: 31817. KW 12342. KVAR 34127. KVA   PF:   .93  LAGGING
LOSSES THRU FEEDER:        2. KW       11. KVAR       11. KVA


==== BUS:    5 C8X5       DESIGN VOLTAGE: 13800  BUS VOLTAGE: 14442 %VD: -4.7
========================= PU BUS VOLTAGE:   1.05       ANGLE:  -7.8 DEGREES

LOAD FROM:    1 A8 BUS 1      FEEDER AMPS:   329 VOLTAGE DROP:    0. %VD:   .0
PROJECTED POWER FLOW:  7554. KW  3273. KVAR  8233. KVA   PF:   .92  LAGGING
LOSSES THRU FEEDER:        0. KW        0. KVAR        0. KVA
```

```
                 BALANCED VOLTAGE DROP AND LOAD FLOW ANALYSIS
******************************************************************************
VOLTAGE EFFECT ON LOADS MODELED
VOLTAGE DROP CRITERIA: BRANCH =  4.00 %   BUS =  5.00


LOAD   TO: 5000 L5 RISER     FEEDER AMPS:   329 VOLTAGE DROP:    3. %VD:   .0
PROJECTED POWER FLOW:  7554. KW  3273. KVAR  8233. KVA    PF:   .92  LAGGING
LOSSES THRU FEEDER:        1. KW       2. KVAR       2. KVA


==== BUS:    8 C8X8       DESIGN VOLTAGE: 13800  BUS VOLTAGE: 14408 %VD: -4.4
========================= PU BUS VOLTAGE:   1.04        ANGLE:  -7.9 DEGREES

LOAD FROM:     2 A8 BUS 2    FEEDER AMPS:   347 VOLTAGE DROP:    0. %VD:   .0
PROJECTED POWER FLOW:  7835. KW  3703. KVAR  8666. KVA    PF:   .90  LAGGING
LOSSES THRU FEEDER:        0. KW       0. KVAR       0. KVA

LOAD   TO: 8000 L8 RISER     FEEDER AMPS:   347 VOLTAGE DROP:    6. %VD:   .0
PROJECTED POWER FLOW:  7835. KW  3703. KVAR  8666. KVA    PF:   .90  LAGGING
LOSSES THRU FEEDER:        2. KW       4. KVAR       4. KVA


==== BUS:   10 C8XNEW1    DESIGN VOLTAGE: 13800  BUS VOLTAGE: 14442 %VD: -4.7
========================= PU BUS VOLTAGE:   1.05        ANGLE:  -7.8 DEGREES

LOAD FROM:     1 A8 BUS 1    FEEDER AMPS:   330 VOLTAGE DROP:    0. %VD:   .0
PROJECTED POWER FLOW:  7580. KW  3243. KVAR  8244. KVA    PF:   .92  LAGGING
LOSSES THRU FEEDER:        0. KW       0. KVAR       0. KVA

LOAD   TO: 1000 NEW1 RISER   FEEDER AMPS:   330 VOLTAGE DROP:    6. %VD:   .0
PROJECTED POWER FLOW:  7580. KW  3243. KVAR  8244. KVA    PF:   .92  LAGGING
LOSSES THRU FEEDER:        2. KW       3. KVAR       4. KVA


==== BUS:   20 C8XNEW2    DESIGN VOLTAGE: 13800  BUS VOLTAGE: 14408 %VD: -4.4
========================= PU BUS VOLTAGE:   1.04        ANGLE:  -7.9 DEGREES

LOAD FROM:     2 A8 BUS 2    FEEDER AMPS:   331 VOLTAGE DROP:    0. %VD:   .0
PROJECTED POWER FLOW:  7583. KW  3248. KVAR  8249. KVA    PF:   .92  LAGGING
LOSSES THRU FEEDER:        0. KW       0. KVAR       0. KVA

LOAD   TO: 2000 NEW2 RISER   FEEDER AMPS:   331 VOLTAGE DROP:    6. %VD:   .0
PROJECTED POWER FLOW:  7583. KW  3248. KVAR  8249. KVA    PF:   .92  LAGGING
LOSSES THRU FEEDER:        2. KW       3. KVAR       4. KVA
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                BALANCED VOLTAGE DROP AND LOAD FLOW ANALYSIS
*********************************************************************************
VOLTAGE EFFECT ON LOADS MODELED
VOLTAGE DROP CRITERIA: BRANCH =  4.00 %   BUS =  5.00


==== BUS:  100 A2702C SEC DESIGN VOLTAGE: 13800  BUS VOLTAGE: 14445 %VD: -4.7
========================= PU BUS VOLTAGE:   1.05       ANGLE:  -7.8 DEGREES

LOAD   TO:    1 A8 BUS 1     FEEDER AMPS:  1347 VOLTAGE DROP:    3. %VD:    .0
PROJECTED POWER FLOW: 31536. KW 11917. KVAR 33713. KVA    PF:   .94   LAGGING
LOSSES THRU FEEDER:        2. KW      11. KVAR      11. KVA

LOAD FROM:  234 BPA          TRANSF AMPS:  1347 VOLTAGE DROP: -764. %VD: -5.5
PROJECTED POWER FLOW: 31536. KW 11917. KVAR 33713. KVA    PF:   .94   LAGGING
LOSSES THRU TRANSF:    141.5 KW 4783.5 KVAR 4785.6 KVA ***XFMR TAPS  -5.0%***

LOAD FROM: 9999 ZIGZAG #1    TRANSF AMPS:       VOLTAGE DROP:    0. %VD:    .0
PROJECTED POWER FLOW:     0. KW     0. KVAR     0. KVA    PF:   .00   LAGGING
LOSSES THRU TRANSF:       .0 KW     .0 KVAR     .0 KVA


==== BUS:  200 A2703C SEC DESIGN VOLTAGE: 13800  BUS VOLTAGE: 14411 %VD: -4.4
========================= PU BUS VOLTAGE:   1.04       ANGLE:  -7.9 DEGREES

LOAD   TO:    2 A8 BUS 2     FEEDER AMPS:  1367 VOLTAGE DROP:    3. %VD:    .0
PROJECTED POWER FLOW: 31820. KW 12353. KVAR 34133. KVA    PF:   .93   LAGGING
LOSSES THRU FEEDER:        2. KW      11. KVAR      11. KVA

LOAD FROM:  234 BPA          TRANSF AMPS:  1367 VOLTAGE DROP: -730. %VD: -5.3
PROJECTED POWER FLOW: 31820. KW 12353. KVAR 34133. KVA    PF:   .93   LAGGING
LOSSES THRU TRANSF:    140.4 KW 4948.2 KVAR 4950.2 KVA ***XFMR TAPS  -5.0%***

LOAD FROM: 8999 ZIGZAG #2    TRANSF AMPS:       VOLTAGE DROP:    0. %VD:    .0
PROJECTED POWER FLOW:     0. KW     0. KVAR     0. KVA    PF:   .00   LAGGING
LOSSES THRU TRANSF:       .0 KW     .0 KVAR     .0 KVA


==== BUS:  234 BPA        DESIGN VOLTAGE:234400  BUS VOLTAGE:232382 %VD:    .9
========================= PU BUS VOLTAGE:    .99       ANGLE:   -.7 DEGREES
              *** SWING  GENERATOR:    1     63761. KW    35089. KVAR

LOAD   TO:  100 A2702C SEC   TRANSF AMPS:    89 VOLTAGE DROP:****** %VD: -5.5
PROJECTED POWER FLOW: 31678. KW 16701. KVAR 35811. KVA    PF:   .88   LAGGING
LOSSES THRU TRANSF:    141.5 KW 4783.5 KVAR 4785.6 KVA ***XFMR TAPS  -5.0%***

LOAD   TO:  200 A2703C SEC   TRANSF AMPS:    90 VOLTAGE DROP:****** %VD: -5.3
PROJECTED POWER FLOW: 31960. KW 17301. KVAR 36342. KVA    PF:   .88   LAGGING
LOSSES THRU TRANSF:    140.4 KW 4948.2 KVAR 4950.2 KVA ***XFMR TAPS  -5.0%***
```

```
                BALANCED VOLTAGE DROP AND LOAD FLOW ANALYSIS
******************************************************************************
VOLTAGE EFFECT ON LOADS MODELED
VOLTAGE DROP CRITERIA: BRANCH =  4.00 %   BUS =  5.00


LOAD FROM: **** SOURCE INT   FEEDER AMPS:   179 VOLTAGE DROP: 2018. %VD:   .9
PROJECTED POWER FLOW: 63638. KW 34002. KVAR 72152. KVA    PF:   .88  LAGGING
LOSSES THRU FEEDER:     123. KW    1087. KVAR    1094. KVA


==== BUS: 1000 NEW1 RISER DESIGN VOLTAGE: 13800  BUS VOLTAGE: 14437 %VD: -4.6
========================= PU BUS VOLTAGE:   1.05       ANGLE:  -7.8 DEGREES

LOAD FROM:   10 C8XNEW1      FEEDER AMPS:   330 VOLTAGE DROP:    6. %VD:   .0
PROJECTED POWER FLOW:  7578. KW  3240. KVAR  8241. KVA    PF:   .92  LAGGING
LOSSES THRU FEEDER:       2. KW       3. KVAR      4. KVA

LOAD   TO: 1800 8TH STREET   FEEDER AMPS:   330 VOLTAGE DROP: 1154. %VD:  8.4$
PROJECTED POWER FLOW:  7578. KW  3240. KVAR  8241. KVA    PF:   .92  LAGGING
LOSSES THRU FEEDER:     401. KW     794. KVAR     890. KVA


==== BUS: 1800 8TH STREET DESIGN VOLTAGE: 13800  BUS VOLTAGE: 13282 %VD:  3.8
========================= PU BUS VOLTAGE:    .96       ANGLE: -12.2 DEGREES

LOAD FROM: 1000 NEW1 RISER   FEEDER AMPS:   330 VOLTAGE DROP: 1154. %VD:  8.4$
PROJECTED POWER FLOW:  7177. KW  2445. KVAR  7582. KVA    PF:   .95  LAGGING
LOSSES THRU FEEDER:     401. KW     794. KVAR     890. KVA

LOAD   TO: 1900 TWRS #2      FEEDER AMPS:   330 VOLTAGE DROP:  144. %VD:  1.0
PROJECTED POWER FLOW:  7177. KW  2445. KVAR  7582. KVA    PF:   .95  LAGGING
LOSSES THRU FEEDER:      52. KW     103. KVAR     116. KVA


==== BUS: 1900 TWRS #2    DESIGN VOLTAGE: 13800  BUS VOLTAGE: 13138 %VD:  4.8
========================= PU BUS VOLTAGE:    .95       ANGLE: -12.8 DEGREES
               NET BRANCH DIVERSITY LOAD:   7125. KW   2342. KVAR

LOAD FROM: 1800 8TH STREET   FEEDER AMPS:   330 VOLTAGE DROP:  144. %VD:  1.0
PROJECTED POWER FLOW:  7125. KW  2342. KVAR  7500. KVA    PF:   .95  LAGGING
LOSSES THRU FEEDER:      52. KW     103. KVAR     116. KVA
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                BALANCED VOLTAGE DROP AND LOAD FLOW ANALYSIS
***************************************************************************
VOLTAGE EFFECT ON LOADS MODELED
VOLTAGE DROP CRITERIA: BRANCH =  4.00 %   BUS =  5.00


==== BUS: 2000 NEW2 RISER DESIGN VOLTAGE: 13800  BUS VOLTAGE: 14403 %VD: -4.4
========================= PU BUS VOLTAGE:   1.04       ANGLE:  -8.0 DEGREES

LOAD FROM:   20 C8XNEW2     FEEDER AMPS:   331 VOLTAGE DROP:    6. %VD:    .0
PROJECTED POWER FLOW:  7581. KW  3245. KVAR  8246. KVA    PF:   .92   LAGGING
LOSSES THRU FEEDER:        2. KW        3. KVAR       4. KVA

LOAD   TO: 2800 8TH STREET  FEEDER AMPS:   331 VOLTAGE DROP: 1158. %VD:  8.4$
PROJECTED POWER FLOW:  7581. KW  3245. KVAR  8246. KVA    PF:   .92   LAGGING
LOSSES THRU FEEDER:      403. KW      799. KVAR     895. KVA


==== BUS: 2800 8TH STREET DESIGN VOLTAGE: 13800  BUS VOLTAGE: 13245 %VD:  4.0
========================= PU BUS VOLTAGE:    .96       ANGLE: -12.3 DEGREES

LOAD FROM: 2000 NEW2 RISER  FEEDER AMPS:   331 VOLTAGE DROP: 1158. %VD:  8.4$
PROJECTED POWER FLOW:  7177. KW  2446. KVAR  7583. KVA    PF:   .95   LAGGING
LOSSES THRU FEEDER:      403. KW      799. KVAR     895. KVA

LOAD   TO: 2900 TWRS #1     FEEDER AMPS:   331 VOLTAGE DROP:  145. %VD:  1.0
PROJECTED POWER FLOW:  7177. KW  2446. KVAR  7583. KVA    PF:   .95   LAGGING
LOSSES THRU FEEDER:       52. KW      104. KVAR     116. KVA


==== BUS: 2900 TWRS #1    DESIGN VOLTAGE: 13800  BUS VOLTAGE: 13100 %VD:  5.1$
========================= PU BUS VOLTAGE:    .95       ANGLE: -12.9 DEGREES
               NET BRANCH DIVERSITY LOAD:  7125. KW   2342. KVAR

LOAD FROM: 2800 8TH STREET  FEEDER AMPS:   331 VOLTAGE DROP:  145. %VD:  1.0
PROJECTED POWER FLOW:  7125. KW  2342. KVAR  7500. KVA    PF:   .95   LAGGING
LOSSES THRU FEEDER:       52. KW      104. KVAR     116. KVA


==== BUS: 5000 L5 RISER   DESIGN VOLTAGE: 13800  BUS VOLTAGE: 14439 %VD: -4.6
========================= PU BUS VOLTAGE:   1.05       ANGLE:  -7.8 DEGREES

LOAD FROM:    5 C8X5        FEEDER AMPS:   329 VOLTAGE DROP:    3. %VD:    .0
PROJECTED POWER FLOW:  7553. KW  3271. KVAR  8231. KVA    PF:   .92   LAGGING
LOSSES THRU FEEDER:        1. KW        2. KVAR       2. KVA

LOAD   TO: 5200 C8X110      FEEDER AMPS:   329 VOLTAGE DROP:  884. %VD:  6.4$
PROJECTED POWER FLOW:  7553. KW  3271. KVAR  8231. KVA    PF:   .92   LAGGING
LOSSES THRU FEEDER:      290. KW      636. KVAR     699. KVA
```

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                BALANCED VOLTAGE DROP AND LOAD FLOW ANALYSIS
******************************************************************************
VOLTAGE EFFECT ON LOADS MODELED
VOLTAGE DROP CRITERIA: BRANCH =  4.00 %   BUS =  5.00


==== BUS: 5200 C8X110     DESIGN VOLTAGE: 13800  BUS VOLTAGE: 13555 %VD:  1.8
========================= PU BUS VOLTAGE:     .98       ANGLE: -11.3 DEGREES

LOAD FROM: 5000 L5 RISER     FEEDER AMPS:   329 VOLTAGE DROP:  884. %VD:  6.4$
PROJECTED POWER FLOW:  7264. KW  2635. KVAR  7727. KVA    PF:   .94  LAGGING
LOSSES THRU FEEDER:     290. KW     636. KVAR    699. KVA

LOAD   TO: 5800 8TH STREET   FEEDER AMPS:   329 VOLTAGE DROP:  254. %VD:  1.8
PROJECTED POWER FLOW:  7264. KW  2635. KVAR  7727. KVA    PF:   .94  LAGGING
LOSSES THRU FEEDER:      87. KW     190. KVAR    209. KVA


==== BUS: 5800 8TH STREET DESIGN VOLTAGE: 13800  BUS VOLTAGE: 13301 %VD:  3.6
========================= PU BUS VOLTAGE:     .96       ANGLE: -12.4 DEGREES

LOAD FROM: 5200 C8X110       FEEDER AMPS:   329 VOLTAGE DROP:  254. %VD:  1.8
PROJECTED POWER FLOW:  7177. KW  2445. KVAR  7582. KVA    PF:   .95  LAGGING
LOSSES THRU FEEDER:      87. KW     190. KVAR    209. KVA

LOAD   TO: 5900 TWRS #1      FEEDER AMPS:   329 VOLTAGE DROP:  144. %VD:  1.0
PROJECTED POWER FLOW:  7177. KW  2445. KVAR  7582. KVA    PF:   .95  LAGGING
LOSSES THRU FEEDER:      52. KW     103. KVAR    115. KVA


==== BUS: 5900 TWRS #1    DESIGN VOLTAGE: 13800  BUS VOLTAGE: 13157 %VD:  4.7
========================= PU BUS VOLTAGE:     .95       ANGLE: -13.1 DEGREES
                NET BRANCH DIVERSITY LOAD:   7125. KW   2342. KVAR

LOAD FROM: 5800 8TH STREET   FEEDER AMPS:   329 VOLTAGE DROP:  144. %VD:  1.0
PROJECTED POWER FLOW:  7125. KW  2342. KVAR  7500. KVA    PF:   .95  LAGGING
LOSSES THRU FEEDER:      52. KW     103. KVAR    115. KVA


==== BUS: 8000 L8 RISER   DESIGN VOLTAGE: 13800  BUS VOLTAGE: 14402 %VD: -4.4
========================= PU BUS VOLTAGE:   1.04        ANGLE:  -8.0 DEGREES

LOAD FROM:    8 C8X8         FEEDER AMPS:   347 VOLTAGE DROP:    6. %VD:   .0
PROJECTED POWER FLOW:  7832. KW  3700. KVAR  8662. KVA    PF:   .90  LAGGING
LOSSES THRU FEEDER:       2. KW       4. KVAR      4. KVA

LOAD   TO: 8200 C8X294       FEEDER AMPS:   347 VOLTAGE DROP: 1384. %VD: 10.0$
PROJECTED POWER FLOW:  7832. KW  3700. KVAR  8662. KVA    PF:   .90  LAGGING
LOSSES THRU FEEDER:     502. KW     948. KVAR   1073. KVA
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                BALANCED VOLTAGE DROP AND LOAD FLOW ANALYSIS
******************************************************************************
VOLTAGE EFFECT ON LOADS MODELED
VOLTAGE DROP CRITERIA: BRANCH =  4.00 %   BUS =  5.00


==== BUS: 8200 C8X294     DESIGN VOLTAGE: 13800  BUS VOLTAGE: 13018 %VD:  5.7$
========================= PU BUS VOLTAGE:     .94       ANGLE: -12.7 DEGREES

LOAD FROM: 8000 L8 RISER     FEEDER AMPS:   347 VOLTAGE DROP: 1384. %VD: 10.0$
PROJECTED POWER FLOW:  7330. KW  2752. KVAR  7830. KVA    PF:    .94  LAGGING
LOSSES THRU FEEDER:     502. KW     948. KVAR    1073. KVA

LOAD   TO: 8700 EXT #1       FEEDER AMPS:   347 VOLTAGE DROP:  264. %VD:  1.9
PROJECTED POWER FLOW:  7330. KW  2752. KVAR  7830. KVA    PF:    .94  LAGGING
LOSSES THRU FEEDER:      99. KW     192. KVAR     216. KVA


==== BUS: 8700 EXT #1     DESIGN VOLTAGE: 13800  BUS VOLTAGE: 12754 %VD:  7.6$
========================= PU BUS VOLTAGE:     .92       ANGLE: -13.7 DEGREES

LOAD FROM: 8200 C8X294       FEEDER AMPS:   347 VOLTAGE DROP:  264. %VD:  1.9
PROJECTED POWER FLOW:  7231. KW  2560. KVAR  7671. KVA    PF:    .94  LAGGING
LOSSES THRU FEEDER:      99. KW     192. KVAR     216. KVA

LOAD   TO: 8750 OLD C8L5     FEEDER AMPS:   347 VOLTAGE DROP:   18. %VD:   .1
PROJECTED POWER FLOW:  7231. KW  2560. KVAR  7671. KVA    PF:    .94  LAGGING
LOSSES THRU FEEDER:       7. KW      13. KVAR      15. KVA


==== BUS: 8750 OLD C8L5   DESIGN VOLTAGE: 13800  BUS VOLTAGE: 12736 %VD:  7.7$
========================= PU BUS VOLTAGE:     .92       ANGLE: -13.8 DEGREES

LOAD FROM: 8700 EXT #1       FEEDER AMPS:   347 VOLTAGE DROP:   18. %VD:   .1
PROJECTED POWER FLOW:  7224. KW  2547. KVAR  7660. KVA    PF:    .94  LAGGING
LOSSES THRU FEEDER:       7. KW      13. KVAR      15. KVA

LOAD   TO: 8800 8TH STREET   FEEDER AMPS:   347 VOLTAGE DROP:  114. %VD:   .8
PROJECTED POWER FLOW:  7224. KW  2547. KVAR  7660. KVA    PF:    .94  LAGGING
LOSSES THRU FEEDER:      41. KW      91. KVAR     100. KVA


==== BUS: 8800 8TH STREET DESIGN VOLTAGE: 13800  BUS VOLTAGE: 12622 %VD:  8.5$
========================= PU BUS VOLTAGE:     .91       ANGLE: -14.4 DEGREES

LOAD FROM: 8750 OLD C8L5     FEEDER AMPS:   347 VOLTAGE DROP:  114. %VD:   .8
PROJECTED POWER FLOW:  7183. KW  2457. KVAR  7591. KVA    PF:    .95  LAGGING
LOSSES THRU FEEDER:      41. KW      91. KVAR     100. KVA
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                BALANCED VOLTAGE DROP AND LOAD FLOW ANALYSIS
*****************************************************************************
VOLTAGE EFFECT ON LOADS MODELED
VOLTAGE DROP CRITERIA: BRANCH =  4.00 %   BUS =  5.00


LOAD   TO: 8900 TWRS #2      FEEDER AMPS:   347 VOLTAGE DROP:  152. %VD:  1.1
PROJECTED POWER FLOW:  7183. KW  2457. KVAR  7591. KVA    PF:   .95  LAGGING
LOSSES THRU FEEDER:       58. KW     115. KVAR     129. KVA


==== BUS: 8900 TWRS #2    DESIGN VOLTAGE: 13800  BUS VOLTAGE: 12470 %VD:  9.6$
========================= PU BUS VOLTAGE:    .90       ANGLE: -15.0 DEGREES
               NET BRANCH DIVERSITY LOAD:   7125. KW   2342. KVAR

LOAD FROM: 8800 8TH STREET   FEEDER AMPS:   347 VOLTAGE DROP:  152. %VD:  1.1
PROJECTED POWER FLOW:  7125. KW  2342. KVAR  7500. KVA    PF:   .95  LAGGING
LOSSES THRU FEEDER:       58. KW     115. KVAR     129. KVA


==== BUS: 8999 ZIGZAG #2  DESIGN VOLTAGE: 13800  BUS VOLTAGE: 14411 %VD: -4.4
========================= PU BUS VOLTAGE:   1.04       ANGLE:  -7.9 DEGREES
**** NO LOAD SPECIFIED ****


==== BUS: 9999 ZIGZAG #1  DESIGN VOLTAGE: 13800  BUS VOLTAGE: 14445 %VD: -4.7
========================= PU BUS VOLTAGE:   1.05       ANGLE:  -7.8 DEGREES
**** NO LOAD SPECIFIED ****
```

BALANCED VOLTAGE DROP AND LOAD FLOW BUS DATA SUMMARY
****

BUS#	NAME	BASE VOLT	PU VOLT	BUS#	NAME	BASE VOLT	PU VOLT
1	A8 BUS 1	13800.00	1.0466	2	A8 BUS 2	13800.00	1.0441
5	C8X5	13800.00	1.0465	8	C8X8	13800.00	1.0441
10	C8XNEW1	13800.00	1.0465	20	C8XNEW2	13800.00	1.0441
100	A2702C SEC	13800.00	1.0467	200	A2703C SEC	13800.00	1.0443
234	BPA	234400.00	.9914	1000	NEW1 RISER	13800.00	1.0461
1800	8TH STREET	13800.00	.9625	1900	TWRS #2	13800.00	.9520
2000	NEW2 RISER	13800.00	1.0437	2800	8TH STREET	13800.00	.9597
2900	TWRS #1	13800.00	.9493	5000	L5 RISER	13800.00	1.0463
5200	C8X110	13800.00	.9823	5800	8TH STREET	13800.00	.9638
5900	TWRS #1	13800.00	.9534	8000	L8 RISER	13800.00	1.0437
8200	C8X294	13800.00	.9433	8700	EXT #1	13800.00	.9242
8750	OLD C8L5	13800.00	.9229	8800	8TH STREET	13800.00	.9146
8900	TWRS #2	13800.00	.9036	8999	ZIGZAG #2	13800.00	1.0443

BALANCED VOLTAGE DROP AND LOAD FLOW BRANCH DATA SUMMARY
****

FROM	NAME	TO	NAME	TYPE	VD%	AMPS	KVA	RATING%
1	A8 BUS 1	5	C8X5	FDR	.00	329.12	8232.84	54.85
1	A8 BUS 1	10	C8XNEW1	FDR	.00	329.58	8244.46	54.93
1	A8 BUS 1	100	A2702C SEC	FDR	.02	1347.48	33707.07	64.17
2	A8 BUS 2	8	C8X8	FDR	.00	347.24	8665.88	57.87
2	A8 BUS 2	20	C8XNEW2	FDR	.00	330.54	8249.07	55.09
2	A8 BUS 2	200	A2703C SEC	FDR	.02	1367.49	34127.22	65.12
5	C8X5	1	A8 BUS 1	FDR	.00	329.12	8232.82	54.85
5	C8X5	5000	L5 RISER	FDR	.02	329.12	8232.82	60.95
8	C8X8	2	A8 BUS 2	FDR	.00	347.24	8665.86	57.87
8	C8X8	8000	L8 RISER	FDR	.04	347.24	8665.86	57.87
10	C8XNEW1	1	A8 BUS 1	FDR	.00	329.58	8244.44	54.93
10	C8XNEW1	1000	NEW1 RISER	FDR	.04	329.58	8244.44	54.93
20	C8XNEW2	2	A8 BUS 2	FDR	.00	330.54	8249.05	55.09
20	C8XNEW2	2000	NEW2 RISER	FDR	.04	330.54	8249.05	55.09
100	A2702C SEC	1	A8 BUS 1	FDR	.02	1347.48	33712.98	64.17
100	A2702C SEC	234	BPA	TX2	-5.53	1347.48	33712.98	67.43
100	A2702C SEC	9999	ZIGZAG #1	TX2	.00	.00	.00	.00
200	A2703C SEC	2	A8 BUS 2	FDR	.02	1367.49	34133.39	65.12
200	A2703C SEC	234	BPA	TX2	-5.29	1367.49	34133.39	68.27
200	A2703C SEC	8999	ZIGZAG #2	TX2	.00	.00	.00	.00
234	BPA	100	A2702C SEC	TX2	-5.53	88.97	35810.63	71.62
234	BPA	200	A2703C SEC	TX2	-5.29	90.29	36342.46	72.68
1000	NEW1 RISER	10	C8XNEW1	FDR	.04	329.58	8241.29	54.93

BALANCED VOLTAGE DROP AND LOAD FLOW BRANCH DATA SUMMARY
****

FROM	NAME	TO	NAME	TYPE	VD%	AMPS	KVA	RATING%
1000	NEW1 RISER	1800	8TH STREET	FDR	8.37	329.58	8241.29	54.93
1800	8TH STREET	1000	NEW1 RISER	FDR	8.37	329.58	7582.26	54.93
1800	8TH STREET	1900	TWRS #2	FDR	1.04	329.58	7582.26	54.93
1900	TWRS #2	1800	8TH STREET	FDR	1.04	329.58	7499.99	54.93
2000	NEW2 RISER	20	C8XNEW2	FDR	.04	330.54	8245.88	55.09
2000	NEW2 RISER	2800	8TH STREET	FDR	8.39	330.54	8245.88	55.09
2800	8TH STREET	2000	NEW2 RISER	FDR	8.39	330.54	7582.72	55.09
2800	8TH STREET	2900	TWRS #1	FDR	1.05	330.54	7582.72	55.09
2900	TWRS #1	2800	8TH STREET	FDR	1.05	330.54	7499.96	55.09
5000	L5 RISER	5	C8X5	FDR	.02	329.12	8231.15	60.95
5000	L5 RISER	5200	C8X110	FDR	6.41	329.12	8231.15	54.85
5200	C8X110	5000	L5 RISER	FDR	6.41	329.12	7727.06	54.85
5200	C8X110	5800	8TH STREET	FDR	1.84	329.12	7727.06	54.85
5800	8TH STREET	5200	C8X110	FDR	1.84	329.12	7582.04	54.85
5800	8TH STREET	5900	TWRS #1	FDR	1.04	329.12	7582.04	54.85
5900	TWRS #1	5800	8TH STREET	FDR	1.04	329.12	7499.99	54.85
8000	L8 RISER	8	C8X8	FDR	.04	347.24	8662.26	57.87
8000	L8 RISER	8200	C8X294	FDR	10.03	347.24	8662.26	57.87
8200	C8X294	8000	L8 RISER	FDR	10.03	347.24	7829.61	57.87
8200	C8X294	8700	EXT #1	FDR	1.92	347.24	7829.61	57.87
8700	EXT #1	8200	C8X294	FDR	1.92	347.24	7670.62	57.87
8700	EXT #1	8750	OLD C8L5	FDR	.13	347.24	7670.62	57.87
8750	OLD C8L5	8700	EXT #1	FDR	.13	347.24	7660.02	57.87
8750	OLD C8L5	8800	8TH STREET	FDR	.83	347.24	7660.02	57.87
8800	8TH STREET	8750	OLD C8L5	FDR	.83	347.24	7591.30	57.87
8800	8TH STREET	8900	TWRS #2	FDR	1.10	347.24	7591.30	57.87
8900	TWRS #2	8800	8TH STREET	FDR	1.10	347.24	7499.92	57.87
8999	ZIGZAG #2	200	A2703C SEC	TX2	.00	.00	.00	.00
9999	ZIGZAG #1	100	A2702C SEC	TX2	.00	.00	.00	.00

NOTE: FOR FEEDERS, RATING% = LOAD FLOW AMPS / FLA.
FLA = LIBRARY FLA EXCLUDING DUCT BANK AND TEMP. DERATING FOR CABLES.
FLA = BRANCH RECORD INPUT FLA FOR IMPEDANCE DATA.

NOTE: FOR TRANSFORMERS, RATING% = LOAD FLOW KVA / TRANSFORMER FULL LOAD KVA.

27 BUSES

*** T O T A L   S Y S T E M   L O S S E S ***
2461. KW   14941. KVAR

WARNING STUDY CONTAINS 14 VOLTAGE CRITERIA VIOLATIONS
VIOLATIONS DENOTED BY ($) AT BUS AND BRANCH %VD LOCATIONS

BASIC CASE 1 MODEL

Primary transformer modeled at 220 kV primary volts with tap of -5 percent. The fault contribution at substation A8 has been modeled at 234.4 kV. 234.4 kV is the regulatory requirement BPA must meet at the WNP #2 start-up transformers (at Ashe Substation). Substation A8 was modeled with 17.3 MVA at -0.95 power factor on each A8 bus (this is the forecasted load for all non-TWRS Phase I facilities for FY 2003). The Case 1 model uses two new express feeders from substation A8 following the line C8L5 corridor using 336 ACSR aerial conductors. Lines C8L5 and C8L8 were modeled as express feeders to the Phase I TWRS privatization site.

Case 1d - each express feeder was loaded with 10 MVA at -0.95 power factor at the Phase I TWRS site.

Study performed by ICF Kaiser Hanford, Utilities Engineering and Technical Services
Richland, Washington

DATE: 6 FEB 96
TIME: 7 58 AM
FILE: LFC1D.R0

ALL INFORMATION PRESENTED IS FOR REVIEW, APPROVAL
INTERPRETATION AND APPLICATION BY A REGISTERED
ENGINEER ONLY

DAPPER (LOAD FLOW AND VOLTAGE DROP MINI/MICRO VERSION 4.5 LEVEL 1.0)

```
          SWING GENERATORS
   BUS NO     ID STAT VOLTAGE  ANGLE
   ================================
      234      1  1    1.00      .00
NOTICE: BRANCH    -1 A8 SUB     TO  230 A8 SUB      IS OUT OF SERVICE
NOTICE: BRANCH  230 A8 SUB      TO  100 A2702C SEC IS OUT OF SERVICE
NOTICE: BRANCH  230 A8 SUB      TO  200 A2703C SEC IS OUT OF SERVICE
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FEEDER DATA

FEEDER FROM NO NAME	FEEDER TO NO NAME	QTY /PH	VOLTS L-L	LENGTH	FEEDER SIZE TYPE	DESCRIPTION DUCT INSUL
1 A8 BUS 1	5 C8X5	1	13800.	1. M		
IMPEDANCE:	.0230 + J .1115 OHMS/M METERS					
1 A8 BUS 1	10 C8XNEW1	1	13800.	1. M		
IMPEDANCE:	.0230 + J .1115 OHMS/M METERS					
2 A8 BUS 2	8 C8X8	1	13800.	1. M		
IMPEDANCE:	.0230 + J .1115 OHMS/M METERS					
2 A8 BUS 2	20 C8XNEW2	1	13800.	1. M		
IMPEDANCE:	.0230 + J .1115 OHMS/M METERS					
5 C8X5	5000 L5 RISER	1	13800.	46. M		
IMPEDANCE:	.0709 + J .1174 OHMS/M METERS					
8 C8X8	8000 L8 RISER	1	13800.	87. M		
IMPEDANCE:	.0709 + J .1174 OHMS/M METERS					
10 C8XNEW1	1000 NEW1 RISER	1	13800.	87. M		
IMPEDANCE:	.0709 + J .1174 OHMS/M METERS					
20 C8XNEW2	2000 NEW2 RISER	1	13800.	87. M		
IMPEDANCE:	.0709 + J .1174 OHMS/M METERS					
100 A2702C SEC	1 A8 BUS 1	3	13800.	53. M		
IMPEDANCE:	.0230 + J .1115 OHMS/M METERS					
200 A2703C SEC	2 A8 BUS 2	3	13800.	53. M		
IMPEDANCE:	.0230 + J .1116 OHMS/M METERS					
1000 NEW1 RISER	1800 8TH STREET	1	13800.	6148. M		
IMPEDANCE:	.2000 + J .3965 OHMS/M METERS					
1800 8TH STREET	1900 TWRS #2	1	13800.	800. M		
IMPEDANCE:	.2001 + J .3965 OHMS/M METERS					
2000 NEW2 RISER	2800 8TH STREET	1	13800.	6148. M		
IMPEDANCE:	.2001 + J .3965 OHMS/M METERS					
2800 8TH STREET	2900 TWRS #1	1	13800.	800. M		
IMPEDANCE:	.2001 + J .3965 OHMS/M METERS					
5000 L5 RISER	5200 C8X110	1	13800.	4731. M		
IMPEDANCE:	.1883 + J .4135 OHMS/M METERS					

FEEDER DATA

FEEDER FROM NO NAME	FEEDER TO NO NAME	QTY /PH	VOLTS L-L	LENGTH	FEEDER DESCRIPTION SIZE TYPE DUCT INSUL
5200 C8X110	5800 8TH STREET	1	13800.	1417. M	
IMPEDANCE:	.1884 + J .4136 OHMS/M METERS				
5800 8TH STREET	5900 TWRS #1	1	13800.	800. M	
IMPEDANCE:	.2001 + J .3965 OHMS/M METERS				
8000 L8 RISER	8200 C8X294	1	13800.	6942. M	
IMPEDANCE:	.2001 + J .3774 OHMS/M METERS				
8200 C8X294	8700 EXT #1	1	13800.	1372. M	
IMPEDANCE:	.2000 + J .3865 OHMS/M METERS				
8700 EXT #1	8750 OLD C8L5	1	13800.	91. M	
IMPEDANCE:	.2007 + J .3982 OHMS/M METERS				
8750 OLD C8L5	8800 8TH STREET	1	13800.	606. M	
IMPEDANCE:	.1883 + J .4134 OHMS/M METERS				
8800 8TH STREET	8900 TWRS #2	1	13800.	800. M	
IMPEDANCE:	.2001 + J .3965 OHMS/M METERS				

SOURCE BUS THEVENIN EQUIVALENT IMPEDANCE: 1.278144000 + J11.277260000 OHMS
Calculated From Utility Contribution at Bus No. 234

T R A N S F O R M E R   D A T A

PRIMARY RECORD NO	NAME	VOLTS L-L	PRI FLA	* SECONDARY RECORD NO	NAME	VOLTS L-L	SEC FLA	NOMINAL KVA
234	BPA	220000.	79.	100	A2702C SEC	13800.	1255.	30000.0
	IMPEDANCE:	.4092 + J13.8340 PERCENT			TRANSFORMER FIXED TAP:			-5.0 %
234	BPA	220000.	79.	200	A2703C SEC	13800.	1255.	30000.0
	IMPEDANCE:	.3941 + J13.8944 PERCENT			TRANSFORMER FIXED TAP:			-5.0 %
8999	ZIGZAG #2	13800.	69.	200	A2703C SEC	13800.	69.	1657.0
	IMPEDANCE:	.4000 + J 3.1067 PERCENT						
9999	ZIGZAG #1	13800.	69.	100	A2702C SEC	13800.	69.	1657.0
	IMPEDANCE:	.4000 + J 3.1067 PERCENT						

B R A N C H L O A D D A T A

FROM BUS	TO BUS	BR. TYPE	CONSTANT KVA KVA	CONSTANT KVA %PF	CONSTANT Z KVA	CONSTANT Z %PF	CONSTANT I KVA	CONSTANT I %PF	FLOW DIR.
1 A8 BUS 1									
	5 C8X5	FEEDER	10000	-95.0					
	10 C8XNEW1	FEEDER	10000	-95.0					
2 A8 BUS 2									
	8 C8X8	FEEDER	10000	-95.0					
	20 C8XNEW2	FEEDER	10000	-95.0					
5 C8X5									
	5000 L5 RISER	FEEDER	10000	-95.0					
8 C8X8									
	8000 L8 RISER	FEEDER	10000	-95.0					
10 C8XNEW1									
	1000 NEW1 RISER	FEEDER	10000	-95.0					
20 C8XNEW2									
	2000 NEW2 RISER	FEEDER	10000	-95.0					
100 A2702C SEC									
	1 A8 BUS 1	FEEDER	37263	-95.0					
200 A2703C SEC									
	2 A8 BUS 2	FEEDER	37263	-95.0					
1000 NEW1 RISER									
	1800 8TH STREET	FEEDER	10000	-95.0					
1800 8TH STREET									
	1900 TWRS #2	FEEDER	10000	-95.0					
2000 NEW2 RISER									
	2800 8TH STREET	FEEDER	10000	-95.0					
2800 8TH STREET									
	2900 TWRS #1	FEEDER	10000	-95.0					
5000 L5 RISER									
	5200 C8X110	FEEDER	10000	-95.0					
5200 C8X110									
	5800 8TH STREET	FEEDER	10000	-95.0					

BRANCH LOAD DATA

FROM BUS / TO BUS	BR. TYPE	CONSTANT KVA KVA	CONSTANT KVA %PF	CONSTANT Z KVA	CONSTANT Z %PF	CONSTANT I KVA	CONSTANT I %PF	FLOW DIR.
5800 8TH STREET								
5900 TWRS #1	FEEDER	10000	-95.0					
8000 L8 RISER								
8200 C8X294	FEEDER	10000	-95.0					
8200 C8X294								
8700 EXT #1	FEEDER	10000	-95.0					
8700 EXT #1								
8750 OLD C8L5	FEEDER	10000	-95.0					
8750 OLD C8L5								
8800 8TH STREET	FEEDER	10000	-95.0					
8800 8TH STREET								
8900 TWRS #2	FEEDER	10000	-95.0					
234 BPA								
100 A2702C	SEC TRANS.	37263	-95.0					
200 A2703C	SEC TRANS.	37263	-95.0					

*** SOLUTION COMMENTS ***

SOLUTION PARAMETERS

BRANCH VOLTAGE CRITERIA	:	4.00 %
BUS VOLTAGE CRITERIA	:	5.00 %
ACCELERATION FACTOR FOR 'PV' GENERATORS	:	1.00
ACCELERATION FACTOR FOR CONSTANT KVA LOADS	:	1.00
EXACT(ITERATIVE) SOLUTION	:	YES

<<PERCENT VOLTAGE DROPS ARE BASED ON NOMINAL DESIGN VOLTAGES>>

TOF SIZE: 82

LARGEST LOAD: 17263.20 KVA
CONVERGENCE CRITERIA: .863 KVA

LARGEST BUS MISMATCH	8900	TWRS #2	2187.008 KVA
LARGEST BUS MISMATCH	8900	TWRS #2	781.891 KVA
LARGEST BUS MISMATCH	8900	TWRS #2	340.020 KVA
LARGEST BUS MISMATCH	8900	TWRS #2	158.688 KVA
LARGEST BUS MISMATCH	8900	TWRS #2	75.082 KVA
LARGEST BUS MISMATCH	8900	TWRS #2	35.843 KVA
LARGEST BUS MISMATCH	8900	TWRS #2	17.125 KVA
LARGEST BUS MISMATCH	8900	TWRS #2	8.187 KVA
LARGEST BUS MISMATCH	8900	TWRS #2	3.911 KVA
LARGEST BUS MISMATCH	8900	TWRS #2	1.868 KVA
LARGEST BUS MISMATCH	8900	TWRS #2	.891 KVA
LARGEST BUS MISMATCH	8900	TWRS #2	.425 KVA

BALANCED VOLTAGE DROP AND LOAD FLOW ANALYSIS (SWING GENERATORS)

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BUS	VOLTS(PU)	ANGLE	KW	KVAR	VD%	R + JX (PU)
234	1.000	.00	75856.	48753.	1.2	.00233 + J .02053

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                BALANCED VOLTAGE DROP AND LOAD FLOW ANALYSIS
*******************************************************************************
VOLTAGE EFFECT ON LOADS MODELED
VOLTAGE DROP CRITERIA: BRANCH =  4.00 %   BUS =  5.00


==== BUS:     1 A8 BUS 1   DESIGN VOLTAGE: 13800  BUS VOLTAGE: 14090 %VD: -2.1
========================= PU BUS VOLTAGE:    1.02        ANGLE:  -9.5 DEGREES
               NET BRANCH DIVERSITY LOAD:  16400. KW   5390. KVAR

LOAD   TO:    5 C8X5          FEEDER AMPS:   473 VOLTAGE DROP:    0. %VD:    .0
PROJECTED POWER FLOW: 10388. KW  5048. KVAR 11549. KVA     PF:   .90   LAGGING
LOSSES THRU FEEDER:          0. KW        0. KVAR       0. KVA

LOAD   TO:   10 C8XNEW1       FEEDER AMPS:   474 VOLTAGE DROP:    0. %VD:    .0
PROJECTED POWER FLOW: 10442. KW  4988. KVAR 11572. KVA     PF:   .90   LAGGING
LOSSES THRU FEEDER:          0. KW        0. KVAR       0. KVA

LOAD FROM:  100 A2702C SEC    FEEDER AMPS:  1651 VOLTAGE DROP:    3. %VD:    .0
PROJECTED POWER FLOW: 37229. KW 15426. KVAR 40298. KVA     PF:   .92   LAGGING
LOSSES THRU FEEDER:          3. KW       16. KVAR      17. KVA


==== BUS:     2 A8 BUS 2   DESIGN VOLTAGE: 13800  BUS VOLTAGE: 13988 %VD: -1.4
========================= PU BUS VOLTAGE:    1.01        ANGLE:  -9.8 DEGREES
               NET BRANCH DIVERSITY LOAD:  16400. KW   5390. KVAR

LOAD   TO:    8 C8X8          FEEDER AMPS:   527 VOLTAGE DROP:    0. %VD:    .0
PROJECTED POWER FLOW: 11137. KW  6263. KVAR 12777. KVA     PF:   .87   LAGGING
LOSSES THRU FEEDER:          0. KW        0. KVAR       0. KVA

LOAD   TO:   20 C8XNEW2       FEEDER AMPS:   479 VOLTAGE DROP:    0. %VD:    .0
PROJECTED POWER FLOW: 10461. KW  5026. KVAR 11606. KVA     PF:   .90   LAGGING
LOSSES THRU FEEDER:          0. KW        0. KVAR       0. KVA

LOAD FROM:  200 A2703C SEC    FEEDER AMPS:  1713 VOLTAGE DROP:    3. %VD:    .0
PROJECTED POWER FLOW: 37998. KW 16679. KVAR 41497. KVA     PF:   .92   LAGGING
LOSSES THRU FEEDER:          4. KW       17. KVAR      18. KVA


==== BUS:     5 C8X5       DESIGN VOLTAGE: 13800  BUS VOLTAGE: 14090 %VD: -2.1
========================= PU BUS VOLTAGE:    1.02        ANGLE:  -9.5 DEGREES

LOAD FROM:    1 A8 BUS 1      FEEDER AMPS:   473 VOLTAGE DROP:    0. %VD:    .0
PROJECTED POWER FLOW: 10388. KW  5047. KVAR 11549. KVA     PF:   .90   LAGGING
LOSSES THRU FEEDER:          0. KW        0. KVAR       0. KVA
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               BALANCED VOLTAGE DROP AND LOAD FLOW ANALYSIS
*****************************************************************************
VOLTAGE EFFECT ON LOADS MODELED
VOLTAGE DROP CRITERIA: BRANCH =  4.00 %   BUS =  5.00


LOAD   TO: 5000 L5 RISER      FEEDER AMPS:   473 VOLTAGE DROP:     4. %VD:    .0
PROJECTED POWER FLOW: 10388. KW  5047. KVAR 11549. KVA     PF:    .90   LAGGING
LOSSES THRU FEEDER:          2. KW         4. KVAR        4. KVA


==== BUS:    8 C8X8       DESIGN VOLTAGE: 13800  BUS VOLTAGE: 13988 %VD: -1.4
========================= PU BUS VOLTAGE:    1.01        ANGLE:  -9.8 DEGREES

LOAD FROM:     2 A8 BUS 2     FEEDER AMPS:   527 VOLTAGE DROP:     0. %VD:    .0
PROJECTED POWER FLOW: 11137. KW  6263. KVAR 12777. KVA     PF:    .87   LAGGING
LOSSES THRU FEEDER:          0. KW         0. KVAR        0. KVA

LOAD   TO: 8000 L8 RISER      FEEDER AMPS:   527 VOLTAGE DROP:     9. %VD:    .1
PROJECTED POWER FLOW: 11137. KW  6263. KVAR 12777. KVA     PF:    .87   LAGGING
LOSSES THRU FEEDER:          5. KW         9. KVAR       10. KVA


==== BUS:   10 C8XNEW1    DESIGN VOLTAGE: 13800  BUS VOLTAGE: 14090 %VD: -2.1
========================= PU BUS VOLTAGE:    1.02        ANGLE:  -9.5 DEGREES

LOAD FROM:     1 A8 BUS 1     FEEDER AMPS:   474 VOLTAGE DROP:     0. %VD:    .0
PROJECTED POWER FLOW: 10442. KW  4987. KVAR 11572. KVA     PF:    .90   LAGGING
LOSSES THRU FEEDER:          0. KW         0. KVAR        0. KVA

LOAD   TO: 1000 NEW1 RISER    FEEDER AMPS:   474 VOLTAGE DROP:     8. %VD:    .1
PROJECTED POWER FLOW: 10442. KW  4987. KVAR 11572. KVA     PF:    .90   LAGGING
LOSSES THRU FEEDER:          4. KW         7. KVAR        8. KVA


==== BUS:   20 C8XNEW2    DESIGN VOLTAGE: 13800  BUS VOLTAGE: 13988 %VD: -1.4
========================= PU BUS VOLTAGE:    1.01        ANGLE:  -9.8 DEGREES

LOAD FROM:     2 A8 BUS 2     FEEDER AMPS:   479 VOLTAGE DROP:     0. %VD:    .0
PROJECTED POWER FLOW: 10461. KW  5026. KVAR 11606. KVA     PF:    .90   LAGGING
LOSSES THRU FEEDER:          0. KW         0. KVAR        0. KVA

LOAD   TO: 2000 NEW2 RISER    FEEDER AMPS:   479 VOLTAGE DROP:     8. %VD:    .1
PROJECTED POWER FLOW: 10461. KW  5026. KVAR 11606. KVA     PF:    .90   LAGGING
LOSSES THRU FEEDER:          4. KW         7. KVAR        8. KVA
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                BALANCED VOLTAGE DROP AND LOAD FLOW ANALYSIS
*******************************************************************************
VOLTAGE EFFECT ON LOADS MODELED
VOLTAGE DROP CRITERIA: BRANCH =  4.00 %   BUS =  5.00


==== BUS:  100 A2702C SEC DESIGN VOLTAGE: 13800  BUS VOLTAGE: 14093 %VD: -2.1
======================== PU BUS VOLTAGE:   1.02        ANGLE:  -9.5 DEGREES

LOAD   TO:    1 A8 BUS 1      FEEDER AMPS:  1651 VOLTAGE DROP:    3. %VD:   .0
PROJECTED POWER FLOW: 37233. KW 15442. KVAR 40308. KVA    PF:   .92   LAGGING
LOSSES THRU FEEDER:        3. KW      16. KVAR      17. KVA

LOAD FROM:  234 BPA           TRANSF AMPS:  1651 VOLTAGE DROP: -454. %VD: -3.3
PROJECTED POWER FLOW: 37233. KW 15442. KVAR 40308. KVA    PF:   .92   LAGGING
LOSSES THRU TRANSF:     212.5 KW 7183.9 KVAR 7187.0 KVA ***XFMR TAPS  -5.0%***

LOAD FROM: 9999 ZIGZAG #1     TRANSF AMPS:        VOLTAGE DROP:    0. %VD:   .0
PROJECTED POWER FLOW:      0. KW      0. KVAR     0. KVA    PF:   .00   LAGGING
LOSSES THRU TRANSF:        .0 KW      .0 KVAR     .0 KVA


==== BUS:  200 A2703C SEC DESIGN VOLTAGE: 13800  BUS VOLTAGE: 13992 %VD: -1.4
======================== PU BUS VOLTAGE:   1.01        ANGLE:  -9.7 DEGREES

LOAD   TO:    2 A8 BUS 2      FEEDER AMPS:  1713 VOLTAGE DROP:    3. %VD:   .0
PROJECTED POWER FLOW: 38001. KW 16697. KVAR 41507. KVA    PF:   .92   LAGGING
LOSSES THRU FEEDER:        4. KW      17. KVAR      18. KVA

LOAD FROM:  234 BPA           TRANSF AMPS:  1713 VOLTAGE DROP: -353. %VD: -2.6
PROJECTED POWER FLOW: 38001. KW 16697. KVAR 41507. KVA    PF:   .92   LAGGING
LOSSES THRU TRANSF:     220.2 KW 7762.0 KVAR 7765.2 KVA ***XFMR TAPS  -5.0%***

LOAD FROM: 8999 ZIGZAG #2     TRANSF AMPS:        VOLTAGE DROP:    0. %VD:   .0
PROJECTED POWER FLOW:      0. KW      0. KVAR     0. KVA    PF:   .00   LAGGING
LOSSES THRU TRANSF:        .0 KW      .0 KVAR     .0 KVA


==== BUS:  234 BPA            DESIGN VOLTAGE:234400  BUS VOLTAGE:231666 %VD:  1.2
======================== PU BUS VOLTAGE:    .99        ANGLE:   -.8 DEGREES
              *** SWING  GENERATOR:    1      75856. KW     48753. KVAR

LOAD   TO:  100 A2702C SEC    TRANSF AMPS:   109 VOLTAGE DROP:-7710. %VD: -3.3
PROJECTED POWER FLOW: 37445. KW 22626. KVAR 43750. KVA    PF:   .86   LAGGING
LOSSES THRU TRANSF:     212.5 KW 7183.9 KVAR 7187.0 KVA ***XFMR TAPS  -5.0%***

LOAD   TO:  200 A2703C SEC    TRANSF AMPS:   113 VOLTAGE DROP:-5994. %VD: -2.6
PROJECTED POWER FLOW: 38221. KW 24459. KVAR 45377. KVA    PF:   .84   LAGGING
LOSSES THRU TRANSF:     220.2 KW 7762.0 KVAR 7765.2 KVA ***XFMR TAPS  -5.0%***
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                  BALANCED VOLTAGE DROP AND LOAD FLOW ANALYSIS
*******************************************************************************
VOLTAGE EFFECT ON LOADS MODELED
VOLTAGE DROP CRITERIA: BRANCH =  4.00 %   BUS =  5.00


LOAD FROM: **** SOURCE INT   FEEDER AMPS:   222 VOLTAGE DROP: 2734. %VD:  1.2
PROJECTED POWER FLOW: 75667. KW 47084. KVAR 89120. KVA    PF:   .85  LAGGING
LOSSES THRU FEEDER:     189. KW    1669. KVAR    1680. KVA


==== BUS: 1000 NEW1 RISER DESIGN VOLTAGE: 13800  BUS VOLTAGE: 14081 %VD: -2.0
========================= PU BUS VOLTAGE:   1.02       ANGLE:  -9.5 DEGREES

LOAD FROM:   10 C8XNEW1      FEEDER AMPS:   474 VOLTAGE DROP:    8. %VD:   .1
PROJECTED POWER FLOW: 10437. KW  4981. KVAR 11565. KVA    PF:   .90  LAGGING
LOSSES THRU FEEDER:       4. KW       7. KVAR       8. KVA

LOAD   TO: 1800 8TH STREET   FEEDER AMPS:   474 VOLTAGE DROP: 1697. %VD: 12.3$
PROJECTED POWER FLOW: 10437. KW  4981. KVAR 11565. KVA    PF:   .90  LAGGING
LOSSES THRU FEEDER:     829. KW    1644. KVAR    1842. KVA


==== BUS: 1800 8TH STREET DESIGN VOLTAGE: 13800  BUS VOLTAGE: 12384 %VD: 10.3$
========================= PU BUS VOLTAGE:    .90       ANGLE: -15.9 DEGREES

LOAD FROM: 1000 NEW1 RISER   FEEDER AMPS:   474 VOLTAGE DROP: 1697. %VD: 12.3$
PROJECTED POWER FLOW:  9608. KW  3336. KVAR 10171. KVA    PF:   .94  LAGGING
LOSSES THRU FEEDER:     829. KW    1644. KVAR    1842. KVA

LOAD   TO: 1900 TWRS #2      FEEDER AMPS:   474 VOLTAGE DROP:  208. %VD:  1.5
PROJECTED POWER FLOW:  9608. KW  3336. KVAR 10171. KVA    PF:   .94  LAGGING
LOSSES THRU FEEDER:     108. KW     214. KVAR     240. KVA


==== BUS: 1900 TWRS #2    DESIGN VOLTAGE: 13800  BUS VOLTAGE: 12176 %VD: 11.8$
========================= PU BUS VOLTAGE:    .88       ANGLE: -16.8 DEGREES
                NET BRANCH DIVERSITY LOAD:   9500. KW   3122. KVAR

LOAD FROM: 1800 8TH STREET   FEEDER AMPS:   474 VOLTAGE DROP:  208. %VD:  1.5
PROJECTED POWER FLOW:  9500. KW  3122. KVAR 10000. KVA    PF:   .95  LAGGING
LOSSES THRU FEEDER:     108. KW     214. KVAR     240. KVA
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                BALANCED VOLTAGE DROP AND LOAD FLOW ANALYSIS
*******************************************************************************
VOLTAGE EFFECT ON LOADS MODELED
VOLTAGE DROP CRITERIA: BRANCH =  4.00 %   BUS =  5.00


==== BUS: 2000 NEW2 RISER DESIGN VOLTAGE: 13800  BUS VOLTAGE: 13980 %VD: -1.3
========================= PU BUS VOLTAGE:    1.01       ANGLE:  -9.8 DEGREES

LOAD FROM:   20 C8XNEW2      FEEDER AMPS:   479 VOLTAGE DROP:    8. %VD:    .1
PROJECTED POWER FLOW: 10457. KW  5019. KVAR 11599. KVA    PF:   .90  LAGGING
LOSSES THRU FEEDER:        4. KW       7. KVAR      8. KVA

LOAD   TO: 2800 8TH STREET   FEEDER AMPS:   479 VOLTAGE DROP: 1717. %VD: 12.4$
PROJECTED POWER FLOW: 10457. KW  5019. KVAR 11599. KVA    PF:   .90  LAGGING
LOSSES THRU FEEDER:      847. KW    1678. KVAR   1879. KVA


==== BUS: 2800 8TH STREET DESIGN VOLTAGE: 13800  BUS VOLTAGE: 12263 %VD: 11.1$
========================= PU BUS VOLTAGE:     .89       ANGLE: -16.2 DEGREES

LOAD FROM: 2000 NEW2 RISER   FEEDER AMPS:   479 VOLTAGE DROP: 1717. %VD: 12.4$
PROJECTED POWER FLOW:  9610. KW  3341. KVAR 10174. KVA    PF:   .94  LAGGING
LOSSES THRU FEEDER:      847. KW    1678. KVAR   1879. KVA

LOAD   TO: 2900 TWRS #1      FEEDER AMPS:   479 VOLTAGE DROP:  210. %VD:  1.5
PROJECTED POWER FLOW:  9610. KW  3341. KVAR 10174. KVA    PF:   .94  LAGGING
LOSSES THRU FEEDER:      110. KW     218. KVAR    245. KVA


==== BUS: 2900 TWRS #1    DESIGN VOLTAGE: 13800  BUS VOLTAGE: 12053 %VD: 12.7$
========================= PU BUS VOLTAGE:     .87       ANGLE: -17.2 DEGREES
                NET BRANCH DIVERSITY LOAD:   9500. KW   3122. KVAR

LOAD FROM: 2800 8TH STREET   FEEDER AMPS:   479 VOLTAGE DROP:  210. %VD:  1.5
PROJECTED POWER FLOW:  9500. KW  3122. KVAR 10000. KVA    PF:   .95  LAGGING
LOSSES THRU FEEDER:      110. KW     218. KVAR    245. KVA


==== BUS: 5000 L5 RISER   DESIGN VOLTAGE: 13800  BUS VOLTAGE: 14085 %VD: -2.1
========================= PU BUS VOLTAGE:    1.02       ANGLE:  -9.5 DEGREES

LOAD FROM:    5 C8X5         FEEDER AMPS:   473 VOLTAGE DROP:    4. %VD:    .0
PROJECTED POWER FLOW: 10385. KW  5044. KVAR 11546. KVA    PF:   .90  LAGGING
LOSSES THRU FEEDER:        2. KW       4. KVAR      4. KVA

LOAD   TO: 5200 C8X110       FEEDER AMPS:   473 VOLTAGE DROP: 1308. %VD:  9.5$
PROJECTED POWER FLOW: 10385. KW  5044. KVAR 11546. KVA    PF:   .90  LAGGING
LOSSES THRU FEEDER:      599. KW    1314. KVAR   1444. KVA
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                BALANCED VOLTAGE DROP AND LOAD FLOW ANALYSIS
*****************************************************************************
VOLTAGE EFFECT ON LOADS MODELED
VOLTAGE DROP CRITERIA: BRANCH =  4.00 %   BUS =  5.00


==== BUS: 5200 C8X110     DESIGN VOLTAGE: 13800  BUS VOLTAGE: 12777 %VD:  7.4$
========================= PU BUS VOLTAGE:    .93       ANGLE: -14.5 DEGREES

LOAD FROM: 5000 L5 RISER     FEEDER AMPS:   473 VOLTAGE DROP: 1308. %VD:  9.5$
PROJECTED POWER FLOW:  9787. KW  3729. KVAR 10473. KVA    PF:   .93  LAGGING
LOSSES THRU FEEDER:     599. KW   1314. KVAR   1444. KVA

LOAD   TO: 5800 8TH STREET   FEEDER AMPS:   473 VOLTAGE DROP:  370. %VD:  2.7
PROJECTED POWER FLOW:  9787. KW  3729. KVAR 10473. KVA    PF:   .93  LAGGING
LOSSES THRU FEEDER:     179. KW    394. KVAR    433. KVA


==== BUS: 5800 8TH STREET DESIGN VOLTAGE: 13800  BUS VOLTAGE: 12407 %VD: 10.1$
========================= PU BUS VOLTAGE:    .90       ANGLE: -16.2 DEGREES

LOAD FROM: 5200 C8X110       FEEDER AMPS:   473 VOLTAGE DROP:  370. %VD:  2.7
PROJECTED POWER FLOW:  9608. KW  3336. KVAR 10170. KVA    PF:   .94  LAGGING
LOSSES THRU FEEDER:     179. KW    394. KVAR    433. KVA

LOAD   TO: 5900 TWRS #1      FEEDER AMPS:   473 VOLTAGE DROP:  208. %VD:  1.5
PROJECTED POWER FLOW:  9608. KW  3336. KVAR 10170. KVA    PF:   .94  LAGGING
LOSSES THRU FEEDER:     108. KW    213. KVAR    239. KVA


==== BUS: 5900 TWRS #1    DESIGN VOLTAGE: 13800  BUS VOLTAGE: 12200 %VD: 11.6$
========================= PU BUS VOLTAGE:    .88       ANGLE: -17.2 DEGREES
               NET BRANCH DIVERSITY LOAD:   9500. KW   3122. KVAR

LOAD FROM: 5800 8TH STREET   FEEDER AMPS:   473 VOLTAGE DROP:  208. %VD:  1.5
PROJECTED POWER FLOW:  9500. KW  3122. KVAR 10000. KVA    PF:   .95  LAGGING
LOSSES THRU FEEDER:     108. KW    213. KVAR    239. KVA


==== BUS: 8000 L8 RISER   DESIGN VOLTAGE: 13800  BUS VOLTAGE: 13979 %VD: -1.3
========================= PU BUS VOLTAGE:   1.01       ANGLE:  -9.8 DEGREES

LOAD FROM:    8 C8X8         FEEDER AMPS:   527 VOLTAGE DROP:    9. %VD:   .1
PROJECTED POWER FLOW: 11131. KW  6254. KVAR 12768. KVA    PF:   .87  LAGGING
LOSSES THRU FEEDER:       5. KW      9. KVAR     10. KVA

LOAD   TO: 8200 C8X294       FEEDER AMPS:   527 VOLTAGE DROP: 2187. %VD: 15.8$
PROJECTED POWER FLOW: 11131. KW  6254. KVAR 12768. KVA    PF:   .87  LAGGING
LOSSES THRU FEEDER:    1159. KW   2186. KVAR   2474. KVA
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                BALANCED VOLTAGE DROP AND LOAD FLOW ANALYSIS
*****************************************************************************
VOLTAGE EFFECT ON LOADS MODELED
VOLTAGE DROP CRITERIA: BRANCH =  4.00 %   BUS =  5.00


==== BUS: 8200 C8X294     DESIGN VOLTAGE: 13800  BUS VOLTAGE: 11792 %VD: 14.5$
========================= PU BUS VOLTAGE:     .85        ANGLE: -16.9 DEGREES

LOAD FROM: 8000 L8 RISER     FEEDER AMPS:   527 VOLTAGE DROP: 2187. %VD: 15.8$
PROJECTED POWER FLOW:  9973. KW  4069. KVAR 10771. KVA    PF:   .93  LAGGING
LOSSES THRU FEEDER:    1159. KW   2186. KVAR   2474. KVA

LOAD   TO: 8700 EXT #1       FEEDER AMPS:   527 VOLTAGE DROP:  410. %VD:  3.0
PROJECTED POWER FLOW:  9973. KW  4069. KVAR 10771. KVA    PF:   .93  LAGGING
LOSSES THRU FEEDER:     229. KW    442. KVAR    498. KVA


==== BUS: 8700 EXT #1     DESIGN VOLTAGE: 13800  BUS VOLTAGE: 11383 %VD: 17.5$
========================= PU BUS VOLTAGE:     .82        ANGLE: -18.7 DEGREES

LOAD FROM: 8200 C8X294       FEEDER AMPS:   527 VOLTAGE DROP:  410. %VD:  3.0
PROJECTED POWER FLOW:  9744. KW  3626. KVAR 10397. KVA    PF:   .94  LAGGING
LOSSES THRU FEEDER:     229. KW    442. KVAR    498. KVA

LOAD   TO: 8750 OLD C8L5     FEEDER AMPS:   527 VOLTAGE DROP:   27. %VD:   .2
PROJECTED POWER FLOW:  9744. KW  3626. KVAR 10397. KVA    PF:   .94  LAGGING
LOSSES THRU FEEDER:      15. KW     30. KVAR     34. KVA


==== BUS: 8750 OLD C8L5   DESIGN VOLTAGE: 13800  BUS VOLTAGE: 11355 %VD: 17.7$
========================= PU BUS VOLTAGE:     .82        ANGLE: -18.8 DEGREES

LOAD FROM: 8700 EXT #1       FEEDER AMPS:   527 VOLTAGE DROP:   27. %VD:   .2
PROJECTED POWER FLOW:  9729. KW  3596. KVAR 10372. KVA    PF:   .94  LAGGING
LOSSES THRU FEEDER:      15. KW     30. KVAR     34. KVA

LOAD   TO: 8800 8TH STREET   FEEDER AMPS:   527 VOLTAGE DROP:  176. %VD:  1.3
PROJECTED POWER FLOW:  9729. KW  3596. KVAR 10372. KVA    PF:   .94  LAGGING
LOSSES THRU FEEDER:      95. KW    209. KVAR    230. KVA


==== BUS: 8800 8TH STREET DESIGN VOLTAGE: 13800  BUS VOLTAGE: 11180 %VD: 19.0$
========================= PU BUS VOLTAGE:     .81        ANGLE: -19.7 DEGREES

LOAD FROM: 8750 OLD C8L5     FEEDER AMPS:   527 VOLTAGE DROP:  176. %VD:  1.3
PROJECTED POWER FLOW:  9633. KW  3387. KVAR 10211. KVA    PF:   .94  LAGGING
LOSSES THRU FEEDER:      95. KW    209. KVAR    230. KVA
```

```
                BALANCED VOLTAGE DROP AND LOAD FLOW ANALYSIS
******************************************************************************
VOLTAGE EFFECT ON LOADS MODELED
VOLTAGE DROP CRITERIA: BRANCH =  4.00 %   BUS =  5.00


LOAD   TO: 8900 TWRS #2      FEEDER AMPS:   527 VOLTAGE DROP:  232. %VD:  1.7
PROJECTED POWER FLOW:  9633. KW  3387. KVAR 10211. KVA    PF:   .94  LAGGING
LOSSES THRU FEEDER:      134. KW     265. KVAR     296. KVA


==== BUS: 8900 TWRS #2    DESIGN VOLTAGE: 13800  BUS VOLTAGE: 10948 %VD: 20.7$
========================= PU BUS VOLTAGE:    .79       ANGLE: -20.9 DEGREES
               NET BRANCH DIVERSITY LOAD:   9500. KW   3122. KVAR

LOAD FROM: 8800 8TH STREET   FEEDER AMPS:   527 VOLTAGE DROP:  232. %VD:  1.7
PROJECTED POWER FLOW:  9500. KW  3122. KVAR 10000. KVA    PF:   .95  LAGGING
LOSSES THRU FEEDER:      134. KW     265. KVAR     296. KVA


==== BUS: 8999 ZIGZAG #2  DESIGN VOLTAGE: 13800  BUS VOLTAGE: 13992 %VD: -1.4
========================= PU BUS VOLTAGE:   1.01       ANGLE:  -9.7 DEGREES
**** NO LOAD SPECIFIED ****


==== BUS: 9999 ZIGZAG #1  DESIGN VOLTAGE: 13800  BUS VOLTAGE: 14093 %VD: -2.1
========================= PU BUS VOLTAGE:   1.02       ANGLE:  -9.5 DEGREES
**** NO LOAD SPECIFIED ****
```

BALANCED VOLTAGE DROP AND LOAD FLOW BUS DATA SUMMARY
****

BUS#	NAME	BASE VOLT	PU VOLT	BUS#	NAME	BASE VOLT	PU VOLT
1	A8 BUS 1	13800.00	1.0210	2	A8 BUS 2	13800.00	1.0137
5	C8X5	13800.00	1.0210	8	C8X8	13800.00	1.0136
10	C8XNEW1	13800.00	1.0210	20	C8XNEW2	13800.00	1.0137
100	A2702C SEC	13800.00	1.0212	200	A2703C SEC	13800.00	1.0139
234	BPA	234400.00	.9883	1000	NEW1 RISER	13800.00	1.0204
1800	8TH STREET	13800.00	.8974	1900	TWRS #2	13800.00	.8823
2000	NEW2 RISER	13800.00	1.0131	2800	8TH STREET	13800.00	.8886
2900	TWRS #1	13800.00	.8734	5000	L5 RISER	13800.00	1.0207
5200	C8X110	13800.00	.9259	5800	8TH STREET	13800.00	.8991
5900	TWRS #1	13800.00	.8840	8000	L8 RISER	13800.00	1.0130
8200	C8X294	13800.00	.8545	8700	EXT #1	13800.00	.8248
8750	OLD C8L5	13800.00	.8229	8800	8TH STREET	13800.00	.8101
8900	TWRS #2	13800.00	.7933	8999	ZIGZAG #2	13800.00	1.0139

BALANCED VOLTAGE DROP AND LOAD FLOW BRANCH DATA SUMMARY
****

FROM	NAME	TO	NAME	TYPE	VD%	AMPS	KVA	RATING%
1	A8 BUS 1	5	C8X5	FDR	.00	473.25	11549.11	78.87
1	A8 BUS 1	10	C8XNEW1	FDR	.00	474.17	11571.59	79.03
1	A8 BUS 1	100	A2702C SEC	FDR	.02	1651.30	40298.46	78.63
2	A8 BUS 2	8	C8X8	FDR	.00	527.34	12776.86	87.89
2	A8 BUS 2	20	C8XNEW2	FDR	.00	479.01	11605.73	79.83
2	A8 BUS 2	200	A2703C SEC	FDR	.03	1712.73	41497.18	81.56
5	C8X5	1	A8 BUS 1	FDR	.00	473.25	11549.06	78.87
5	C8X5	5000	L5 RISER	FDR	.03	473.25	11549.06	87.64
8	C8X8	2	A8 BUS 2	FDR	.00	527.34	12776.80	87.89
8	C8X8	8000	L8 RISER	FDR	.07	527.34	12776.80	87.89
10	C8XNEW1	1	A8 BUS 1	FDR	.00	474.17	11571.55	79.03
10	C8XNEW1	1000	NEW1 RISER	FDR	.06	474.17	11571.55	79.03
20	C8XNEW2	2	A8 BUS 2	FDR	.00	479.01	11605.68	79.83
20	C8XNEW2	2000	NEW2 RISER	FDR	.06	479.01	11605.68	79.83
100	A2702C SEC	1	A8 BUS 1	FDR	.02	1651.30	40307.77	78.63
100	A2702C SEC	234	BPA	TX2	-3.29	1651.30	40307.77	80.62
100	A2702C SEC	9999	ZIGZAG #1	TX2	.00	.00	.00	.00
200	A2703C SEC	2	A8 BUS 2	FDR	.03	1712.73	41507.50	81.56
200	A2703C SEC	234	BPA	TX2	-2.56	1712.73	41507.50	83.01
200	A2703C SEC	8999	ZIGZAG #2	TX2	.00	.00	.00	.00
234	BPA	100	A2702C SEC	TX2	-3.29	109.03	43749.93	87.50
234	BPA	200	A2703C SEC	TX2	-2.56	113.09	45377.32	90.75
1000	NEW1 RISER	10	C8XNEW1	FDR	.06	474.17	11564.82	79.03

BALANCED VOLTAGE DROP AND LOAD FLOW BRANCH DATA SUMMARY
****

FROM	NAME	TO	NAME	TYPE	VD%	AMPS	KVA	RATING%
1000	NEW1 RISER	1800	8TH STREET	FDR	12.30	474.17	11564.82	79.03
1800	8TH STREET	1000	NEW1 RISER	FDR	12.30	474.17	10170.78	79.03
1800	8TH STREET	1900	TWRS #2	FDR	1.51	474.17	10170.78	79.03
1900	TWRS #2	1800	8TH STREET	FDR	1.51	474.17	9999.98	79.03
2000	NEW2 RISER	20	C8XNEW2	FDR	.06	479.01	11598.81	79.83
2000	NEW2 RISER	2800	8TH STREET	FDR	12.44	479.01	11598.81	79.83
2800	8TH STREET	2000	NEW2 RISER	FDR	12.44	479.01	10174.24	79.83
2800	8TH STREET	2900	TWRS #1	FDR	1.52	479.01	10174.24	79.83
2900	TWRS #1	2800	8TH STREET	FDR	1.52	479.01	9999.91	79.83
5000	L5 RISER	5	C8X5	FDR	.03	473.25	11545.51	87.64
5000	L5 RISER	5200	C8X110	FDR	9.48	473.25	11545.51	78.87
5200	C8X110	5000	L5 RISER	FDR	9.48	473.25	10473.40	78.87
5200	C8X110	5800	8TH STREET	FDR	2.68	473.25	10473.40	78.87
5800	8TH STREET	5200	C8X110	FDR	2.68	473.25	10170.13	78.87
5800	8TH STREET	5900	TWRS #1	FDR	1.50	473.25	10170.13	78.87
5900	TWRS #1	5800	8TH STREET	FDR	1.50	473.25	9999.98	78.87
8000	L8 RISER	8	C8X8	FDR	.07	527.34	12768.14	87.89
8000	L8 RISER	8200	C8X294	FDR	15.85	527.34	12768.14	87.89
8200	C8X294	8000	L8 RISER	FDR	15.85	527.34	10770.78	87.89
8200	C8X294	8700	EXT #1	FDR	2.97	527.34	10770.78	87.89
8700	EXT #1	8200	C8X294	FDR	2.97	527.34	10396.69	87.89
8700	EXT #1	8750	OLD C8L5	FDR	.20	527.34	10396.69	87.89
8750	OLD C8L5	8700	EXT #1	FDR	.20	527.34	10371.90	87.89
8750	OLD C8L5	8800	8TH STREET	FDR	1.27	527.34	10371.90	87.89
8800	8TH STREET	8750	OLD C8L5	FDR	1.27	527.34	10211.46	87.89
8800	8TH STREET	8900	TWRS #2	FDR	1.68	527.34	10211.46	87.89
8900	TWRS #2	8800	8TH STREET	FDR	1.68	527.34	9999.80	87.89
8999	ZIGZAG #2	200	A2703C SEC	TX2	.00	.00	.00	.00
9999	ZIGZAG #1	100	A2702C SEC	TX2	.00	.00	.00	.00

NOTE: FOR FEEDERS, RATING% = LOAD FLOW AMPS / FLA.
FLA = LIBRARY FLA EXCLUDING DUCT BANK AND TEMP. DERATING FOR CABLES.
FLA = BRANCH RECORD INPUT FLA FOR IMPEDANCE DATA.

NOTE: FOR TRANSFORMERS, RATING% = LOAD FLOW KVA / TRANSFORMER FULL LOAD KVA.

27 BUSES

*** T O T A L S Y S T E M L O S S E S ***
5056. KW   25482. KVAR

WARNING STUDY CONTAINS 20 VOLTAGE CRITERIA VIOLATIONS
VIOLATIONS DENOTED BY ($) AT BUS AND BRANCH %VD LOCATIONS

BASIC MODEL

Primary transformer modeled at 220 kV primary volts with tap of -5 percent. The fault contribution at substation A8 has been modeled at 234.4 kV. 234.4 kV is the regulatory requirement BPA must meet at the WNP #2 start-up transformers (at Ashe Substation). Substation A8 was modeled with 17.3 MVA at -0.95 power factor on each A8 bus (this is the forecasted load for all non-TWRS Phase I facilities for FY 2003).

Case 2 - four new express feeders from substation A8 to the proposed Phase I TWRS privatized contractors facilities. The new express feeders were modeled with double circuit hendrix cable, 477 ACSR. Each express feeder was loaded with 10 MVA at -0.95 at the Phase I TWRS site.

Study performed by ICF Kaiser Hanford, Utilities Engineering and Technical Services
Richland, Washington

DATE: 6 FEB 96
TIME: 8 12 AM
FILE: LFC2.R0

ALL INFORMATION PRESENTED IS FOR REVIEW, APPROVAL
INTERPRETATION AND APPLICATION BY A REGISTERED
ENGINEER ONLY

DAPPER (LOAD FLOW AND VOLTAGE DROP MINI/MICRO VERSION 4.5 LEVEL 1.0)

```
          SWING GENERATORS
    BUS NO     ID STAT VOLTAGE  ANGLE
    ================================
       234      1  1    1.00      .00
NOTICE: BRANCH    -1 A8 SUB      TO  230 A8 SUB      IS OUT OF SERVICE
NOTICE: BRANCH  230 A8 SUB      TO  100 A2702C SEC IS OUT OF SERVICE
NOTICE: BRANCH  230 A8 SUB      TO  200 A2703C SEC IS OUT OF SERVICE
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F E E D E R   D A T A

FEEDER FROM NO	NAME	FEEDER TO NO	NAME	QTY /PH	VOLTS L-L	LENGTH	FEEDER SIZE	TYPE	DESCRIPTION DUCT	INSUL
1	A8 BUS 1	10	C8XNEW1	1	13800.	1. M				
	IMPEDANCE:	.0230 + J .1115 OHMS/M METERS								
1	A8 BUS 1	30	C8XNEW3	1	13800.	1. M				
	IMPEDANCE:	.0230 + J .1115 OHMS/M METERS								
2	A8 BUS 2	20	C8XNEW2	1	13800.	1. M				
	IMPEDANCE:	.0230 + J .1115 OHMS/M METERS								
2	A8 BUS 2	40	C8XNEW4	1	13800.	1. M				
	IMPEDANCE:	.0230 + J .1115 OHMS/M METERS								
10	C8XNEW1	1000	NEW1 RISER	1	13800.	87. M				
	IMPEDANCE:	.0472 + J .1122 OHMS/M METERS								
20	C8XNEW2	2000	NEW2 RISER	1	13800.	87. M				
	IMPEDANCE:	.0472 + J .1122 OHMS/M METERS								
30	C8XNEW3	3000	NEW3 RISER	1	13800.	87. M				
	IMPEDANCE:	.0472 + J .1122 OHMS/M METERS								
40	C8XNEW4	4000	NEW4 RISER	1	13800.	87. M				
	IMPEDANCE:	.0472 + J .1122 OHMS/M METERS								
100	A2702C SEC	1	A8 BUS 1	3	13800.	53. M				
	IMPEDANCE:	.0230 + J .1115 OHMS/M METERS								
200	A2703C SEC	2	A8 BUS 2	3	13800.	53. M				
	IMPEDANCE:	.0230 + J .1116 OHMS/M METERS								
1000	NEW1 RISER	1800	8TH STREET	1	13800.	6148. M				
	IMPEDANCE:	.0733 + J .1015 OHMS/M METERS								
1800	8TH STREET	1900	TWRS #1	1	13800.	800. M				
	IMPEDANCE:	.0733 + J .1015 OHMS/M METERS								
2000	NEW2 RISER	2800	8TH STREET	1	13800.	6148. M				
	IMPEDANCE:	.0733 + J .1015 OHMS/M METERS								
2800	8TH STREET	2900	TWRS #1	1	13800.	800. M				
	IMPEDANCE:	.0733 + J .1015 OHMS/M METERS								
3000	NEW3 RISER	3800	8TH STREET	1	13800.	6148. M				
	IMPEDANCE:	.0733 + J .1015 OHMS/M METERS								

FEEDER DATA

FEEDER FROM NO NAME	FEEDER TO NO NAME	QTY /PH	VOLTS L-L	LENGTH	FEEDER SIZE TYPE	DESCRIPTION DUCT INSUL
3800 8TH STREET	3900 TWRS #2	1	13800.	800. M		
IMPEDANCE: .0733 + J .1015 OHMS/M METERS						
4000 NEW4 RISER	4800 8TH STREET	1	13800.	6148. M		
IMPEDANCE: .0733 + J .1015 OHMS/M METERS						
4800 8TH STREET	4900 TWRS #2	1	13800.	800. M		
IMPEDANCE: .0733 + J .1015 OHMS/M METERS						

SOURCE BUS THEVENIN EQUIVALENT IMPEDANCE: 1.278144000 + J11.277260000 OHMS
Calculated From Utility Contribution at Bus No. 234

TRANSFORMER DATA

PRIMARY RECORD NO	NAME	VOLTS L-L	PRI FLA	* SECONDARY RECORD NO	NAME	VOLTS L-L	SEC FLA	NOMINAL KVA
234	BPA	220000.	79.	100	A2702C SEC	13800.	1255.	30000.0
	IMPEDANCE:	.4092 + J13.8340 PERCENT			TRANSFORMER FIXED TAP:			-5.0 %
234	BPA	220000.	79.	200	A2703C SEC	13800.	1255.	30000.0
	IMPEDANCE:	.3941 + J13.8944 PERCENT			TRANSFORMER FIXED TAP:			-5.0 %
8999	ZIGZAG #2	13800.	69.	200	A2703C SEC	13800.	69.	1657.0
	IMPEDANCE:	.4000 + J 3.1067 PERCENT						
9999	ZIGZAG #1	13800.	69.	100	A2702C SEC	13800.	69.	1657.0
	IMPEDANCE:	.4029 + J 3.1063 PERCENT						

B R A N C H   L O A D   D A T A

FROM / TO BUS / BUS	BR. TYPE	CONSTANT KVA KVA	CONSTANT KVA %PF	CONSTANT Z KVA	CONSTANT Z %PF	CONSTANT I KVA	CONSTANT I %PF	FLOW DIR.
1 A8 BUS 1								
10 C8XNEW1	FEEDER	10000	-95.0					
30 C8XNEW3	FEEDER	10000	-95.0					
2 A8 BUS 2								
20 C8XNEW2	FEEDER	10000	-95.0					
40 C8XNEW4	FEEDER	10000	-95.0					
10 C8XNEW1								
1000 NEW1 RISER	FEEDER	10000	-95.0					
20 C8XNEW2								
2000 NEW2 RISER	FEEDER	10000	-95.0					
30 C8XNEW3								
3000 NEW3 RISER	FEEDER	10000	-95.0					
40 C8XNEW4								
4000 NEW4 RISER	FEEDER	10000	-95.0					
100 A2702C SEC								
1 A8 BUS 1	FEEDER	37263	-95.0					
200 A2703C SEC								
2 A8 BUS 2	FEEDER	37263	-95.0					
1000 NEW1 RISER								
1800 8TH STREET	FEEDER	10000	-95.0					
1800 8TH STREET								
1900 TWRS #1	FEEDER	10000	-95.0					
2000 NEW2 RISER								
2800 8TH STREET	FEEDER	10000	-95.0					
2800 8TH STREET								
2900 TWRS #1	FEEDER	10000	-95.0					
3000 NEW3 RISER								
3800 8TH STREET	FEEDER	10000	-95.0					
3800 8TH STREET								
3900 TWRS #2	FEEDER	10000	-95.0					

B R A N C H   L O A D   D A T A

FROM BUS / TO BUS	BR. TYPE	CONSTANT KVA KVA	CONSTANT KVA %PF	CONSTANT Z KVA	CONSTANT Z %PF	CONSTANT I KVA	CONSTANT I %PF	FLOW DIR.
4000 NEW4 RISER								
4800 8TH STREET	FEEDER	10000	-95.0					
4800 8TH STREET								
4900 TWRS #2	FEEDER	10000	-95.0					
234 BPA								
100 A2702C	SEC TRANS.	37263	-95.0					
200 A2703C	SEC TRANS.	37263	-95.0					

*** SOLUTION COMMENTS ***

SOLUTION PARAMETERS

BRANCH VOLTAGE CRITERIA	:	4.00 %
BUS VOLTAGE CRITERIA	:	5.00 %
ACCELERATION FACTOR FOR 'PV' GENERATORS	:	1.00
ACCELERATION FACTOR FOR CONSTANT KVA LOADS	:	1.00
EXACT(ITERATIVE) SOLUTION	:	YES

<<PERCENT VOLTAGE DROPS ARE BASED ON NOMINAL DESIGN VOLTAGES>>

TOF SIZE: 70

LARGEST LOAD:	17263.20 KVA		
CONVERGENCE CRITERIA:	.863 KVA		
LARGEST BUS MISMATCH	1	A8 BUS 1	1278.599 KVA
LARGEST BUS MISMATCH	1	A8 BUS 1	101.208 KVA
LARGEST BUS MISMATCH	1	A8 BUS 1	18.538 KVA
LARGEST BUS MISMATCH	2	A8 BUS 2	3.830 KVA
LARGEST BUS MISMATCH	2	A8 BUS 2	.802 KVA

BALANCED VOLTAGE DROP AND LOAD FLOW ANALYSIS (SWING GENERATORS)
****

BUS	VOLTS(PU)	ANGLE	KW	KVAR	VD%	R + JX (PU)
234	1.000	.00	72395.	38532.	.9	.00233 + J .02053

```
                 BALANCED VOLTAGE DROP AND LOAD FLOW ANALYSIS
******************************************************************************
VOLTAGE EFFECT ON LOADS MODELED
VOLTAGE DROP CRITERIA: BRANCH =  4.00 %   BUS =  5.00


==== BUS:    1 A8 BUS 1   DESIGN VOLTAGE: 13800  BUS VOLTAGE: 14348 %VD: -4.0
======================== PU BUS VOLTAGE:   1.04       ANGLE:  -9.0 DEGREES
              NET BRANCH DIVERSITY LOAD:  16400. KW   5390. KVAR

LOAD   TO:   10 C8XNEW1      FEEDER AMPS:   417 VOLTAGE DROP:    0. %VD:    .0
PROJECTED POWER FLOW:  9769. KW  3497. KVAR 10376. KVA     PF:   .94  LAGGING
LOSSES THRU FEEDER:        0. KW        0. KVAR       0. KVA

LOAD   TO:   30 C8XNEW3      FEEDER AMPS:   417 VOLTAGE DROP:    0. %VD:    .0
PROJECTED POWER FLOW:  9769. KW  3497. KVAR 10376. KVA     PF:   .94  LAGGING
LOSSES THRU FEEDER:        0. KW        0. KVAR       0. KVA

LOAD FROM:  100 A2702C SEC   FEEDER AMPS:  1530 VOLTAGE DROP:    3. %VD:    .0
PROJECTED POWER FLOW: 35937. KW 12384. KVAR 38011. KVA     PF:   .95  LAGGING
LOSSES THRU FEEDER:        3. KW       14. KVAR      14. KVA


==== BUS:    2 A8 BUS 2   DESIGN VOLTAGE: 13800  BUS VOLTAGE: 14346 %VD: -4.0
======================== PU BUS VOLTAGE:   1.04       ANGLE:  -9.0 DEGREES
              NET BRANCH DIVERSITY LOAD:  16400. KW   5390. KVAR

LOAD   TO:   20 C8XNEW2      FEEDER AMPS:   418 VOLTAGE DROP:    0. %VD:    .0
PROJECTED POWER FLOW:  9769. KW  3497. KVAR 10376. KVA     PF:   .94  LAGGING
LOSSES THRU FEEDER:        0. KW        0. KVAR       0. KVA

LOAD   TO:   40 C8XNEW4      FEEDER AMPS:   418 VOLTAGE DROP:    0. %VD:    .0
PROJECTED POWER FLOW:  9769. KW  3497. KVAR 10376. KVA     PF:   .94  LAGGING
LOSSES THRU FEEDER:        0. KW        0. KVAR       0. KVA

LOAD FROM:  200 A2703C SEC   FEEDER AMPS:  1530 VOLTAGE DROP:    3. %VD:    .0
PROJECTED POWER FLOW: 35937. KW 12384. KVAR 38011. KVA     PF:   .95  LAGGING
LOSSES THRU FEEDER:        3. KW       14. KVAR      14. KVA


==== BUS:   10 C8XNEW1    DESIGN VOLTAGE: 13800  BUS VOLTAGE: 14348 %VD: -4.0
======================== PU BUS VOLTAGE:   1.04       ANGLE:  -9.0 DEGREES

LOAD FROM:    1 A8 BUS 1     FEEDER AMPS:   417 VOLTAGE DROP:    0. %VD:    .0
PROJECTED POWER FLOW:  9769. KW  3497. KVAR 10375. KVA     PF:   .94  LAGGING
LOSSES THRU FEEDER:        0. KW        0. KVAR       0. KVA
```

```
                 BALANCED VOLTAGE DROP AND LOAD FLOW ANALYSIS
*****************************************************************************
VOLTAGE EFFECT ON LOADS MODELED
VOLTAGE DROP CRITERIA: BRANCH =  4.00 %   BUS =  5.00


LOAD   TO: 1000 NEW1 RISER   FEEDER AMPS:   417 VOLTAGE DROP:     5. %VD:    .0
PROJECTED POWER FLOW:  9769. KW  3497. KVAR 10375. KVA    PF:   .94  LAGGING
LOSSES THRU FEEDER:        2. KW        5. KVAR       6. KVA


==== BUS:   20 C8XNEW2    DESIGN VOLTAGE: 13800  BUS VOLTAGE: 14346 %VD: -4.0
======================== PU BUS VOLTAGE:   1.04       ANGLE:  -9.0 DEGREES

LOAD FROM:     2 A8 BUS 2     FEEDER AMPS:   418 VOLTAGE DROP:     0. %VD:    .0
PROJECTED POWER FLOW:  9769. KW  3497. KVAR 10376. KVA    PF:   .94  LAGGING
LOSSES THRU FEEDER:        0. KW        0. KVAR       0. KVA

LOAD   TO: 2000 NEW2 RISER   FEEDER AMPS:   418 VOLTAGE DROP:     5. %VD:    .0
PROJECTED POWER FLOW:  9769. KW  3497. KVAR 10376. KVA    PF:   .94  LAGGING
LOSSES THRU FEEDER:        2. KW        5. KVAR       6. KVA


==== BUS:   30 C8XNEW3    DESIGN VOLTAGE: 13800  BUS VOLTAGE: 14348 %VD: -4.0
======================== PU BUS VOLTAGE:   1.04       ANGLE:  -9.0 DEGREES

LOAD FROM:     1 A8 BUS 1     FEEDER AMPS:   417 VOLTAGE DROP:     0. %VD:    .0
PROJECTED POWER FLOW:  9769. KW  3497. KVAR 10375. KVA    PF:   .94  LAGGING
LOSSES THRU FEEDER:        0. KW        0. KVAR       0. KVA

LOAD   TO: 3000 NEW3 RISER   FEEDER AMPS:   417 VOLTAGE DROP:     5. %VD:    .0
PROJECTED POWER FLOW:  9769. KW  3497. KVAR 10375. KVA    PF:   .94  LAGGING
LOSSES THRU FEEDER:        2. KW        5. KVAR       6. KVA


==== BUS:   40 C8XNEW4    DESIGN VOLTAGE: 13800  BUS VOLTAGE: 14346 %VD: -4.0
======================== PU BUS VOLTAGE:   1.04       ANGLE:  -9.0 DEGREES

LOAD FROM:     2 A8 BUS 2     FEEDER AMPS:   418 VOLTAGE DROP:     0. %VD:    .0
PROJECTED POWER FLOW:  9769. KW  3497. KVAR 10376. KVA    PF:   .94  LAGGING
LOSSES THRU FEEDER:        0. KW        0. KVAR       0. KVA

LOAD   TO: 4000 NEW4 RISER   FEEDER AMPS:   418 VOLTAGE DROP:     5. %VD:    .0
PROJECTED POWER FLOW:  9769. KW  3497. KVAR 10376. KVA    PF:   .94  LAGGING
LOSSES THRU FEEDER:        2. KW        5. KVAR       6. KVA
```

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                BALANCED VOLTAGE DROP AND LOAD FLOW ANALYSIS
*****************************************************************************
VOLTAGE EFFECT ON LOADS MODELED
VOLTAGE DROP CRITERIA: BRANCH =  4.00 %   BUS =  5.00


==== BUS:  100 A2702C SEC DESIGN VOLTAGE: 13800  BUS VOLTAGE: 14351 %VD: -4.0
======================== PU BUS VOLTAGE:    1.04        ANGLE:  -9.0 DEGREES

LOAD   TO:     1 A8 BUS 1     FEEDER AMPS:  1530 VOLTAGE DROP:     3. %VD:   .0
PROJECTED POWER FLOW: 35940. KW 12398. KVAR 38018. KVA    PF:    .95   LAGGING
LOSSES THRU FEEDER:        3. KW      14. KVAR      14. KVA

LOAD FROM:  234 BPA           TRANSF AMPS:  1530 VOLTAGE DROP: -682. %VD: -4.9
PROJECTED POWER FLOW: 35940. KW 12398. KVAR 38018. KVA    PF:    .95   LAGGING
LOSSES THRU TRANSF:     182.3 KW 6163.2 KVAR 6165.9 KVA ***XFMR TAPS  -5.0%***

LOAD FROM: 9999 ZIGZAG #1     TRANSF AMPS:         VOLTAGE DROP:     0. %VD:   .0
PROJECTED POWER FLOW:      0. KW      0. KVAR      0. KVA    PF:    .00   LAGGING
LOSSES THRU TRANSF:        .0 KW      .0 KVAR      .0 KVA


==== BUS:  200 A2703C SEC DESIGN VOLTAGE: 13800  BUS VOLTAGE: 14348 %VD: -4.0
======================== PU BUS VOLTAGE:    1.04        ANGLE:  -9.0 DEGREES

LOAD   TO:     2 A8 BUS 2     FEEDER AMPS:  1530 VOLTAGE DROP:     3. %VD:   .0
PROJECTED POWER FLOW: 35940. KW 12398. KVAR 38019. KVA    PF:    .95   LAGGING
LOSSES THRU FEEDER:        3. KW      14. KVAR      14. KVA

LOAD FROM:  234 BPA           TRANSF AMPS:  1530 VOLTAGE DROP: -679. %VD: -4.9
PROJECTED POWER FLOW: 35940. KW 12398. KVAR 38019. KVA    PF:    .95   LAGGING
LOSSES THRU TRANSF:     175.7 KW 6192.5 KVAR 6195.0 KVA ***XFMR TAPS  -5.0%***

LOAD FROM: 8999 ZIGZAG #2     TRANSF AMPS:         VOLTAGE DROP:     0. %VD:   .0
PROJECTED POWER FLOW:      0. KW      0. KVAR      0. KVA    PF:    .00   LAGGING
LOSSES THRU TRANSF:        .0 KW      .0 KVAR      .0 KVA


==== BUS:  234 BPA          DESIGN VOLTAGE:234400  BUS VOLTAGE:232175 %VD:    .9
======================== PU BUS VOLTAGE:     .99        ANGLE:    -.8 DEGREES
             *** SWING  GENERATOR:    1      72395. KW     38532. KVAR

LOAD   TO:  100 A2702C SEC   TRANSF AMPS:   101 VOLTAGE DROP:****** %VD: -4.9
PROJECTED POWER FLOW: 36122. KW 18561. KVAR 40612. KVA    PF:    .89   LAGGING
LOSSES THRU TRANSF:     182.3 KW 6163.2 KVAR 6165.9 KVA ***XFMR TAPS  -5.0%***

LOAD   TO:  200 A2703C SEC   TRANSF AMPS:   101 VOLTAGE DROP:****** %VD: -4.9
PROJECTED POWER FLOW: 36116. KW 18591. KVAR 40620. KVA    PF:    .89   LAGGING
LOSSES THRU TRANSF:     175.7 KW 6192.5 KVAR 6195.0 KVA ***XFMR TAPS  -5.0%***
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```
                BALANCED VOLTAGE DROP AND LOAD FLOW ANALYSIS
******************************************************************************
VOLTAGE EFFECT ON LOADS MODELED
VOLTAGE DROP CRITERIA: BRANCH =  4.00 %   BUS =  5.00


LOAD FROM: **** SOURCE INT   FEEDER AMPS:   202 VOLTAGE DROP: 2226. %VD:   .9
PROJECTED POWER FLOW: 72238. KW 37152. KVAR 81232. KVA    PF:   .89  LAGGING
LOSSES THRU FEEDER:      156. KW    1380. KVAR   1389. KVA


==== BUS: 1000 NEW1 RISER DESIGN VOLTAGE: 13800  BUS VOLTAGE: 14343 %VD: -3.9
========================= PU BUS VOLTAGE:   1.04        ANGLE:  -9.0 DEGREES

LOAD FROM:   10 C8XNEW1      FEEDER AMPS:   417 VOLTAGE DROP:    5. %VD:   .0
PROJECTED POWER FLOW:  9766. KW  3492. KVAR 10372. KVA    PF:   .94  LAGGING
LOSSES THRU FEEDER:        2. KW       5. KVAR      6. KVA

LOAD   TO: 1800 8TH STREET   FEEDER AMPS:   417 VOLTAGE DROP:  455. %VD:  3.3
PROJECTED POWER FLOW:  9766. KW  3492. KVAR 10372. KVA    PF:   .94  LAGGING
LOSSES THRU FEEDER:      236. KW     326. KVAR    403. KVA


==== BUS: 1800 8TH STREET DESIGN VOLTAGE: 13800  BUS VOLTAGE: 13888 %VD:  -.6
========================= PU BUS VOLTAGE:   1.01        ANGLE: -10.3 DEGREES

LOAD FROM: 1000 NEW1 RISER   FEEDER AMPS:   417 VOLTAGE DROP:  455. %VD:  3.3
PROJECTED POWER FLOW:  9531. KW  3165. KVAR 10042. KVA    PF:   .95  LAGGING
LOSSES THRU FEEDER:      236. KW     326. KVAR    403. KVA

LOAD   TO: 1900 TWRS #1      FEEDER AMPS:   417 VOLTAGE DROP:   59. %VD:   .4
PROJECTED POWER FLOW:  9531. KW  3165. KVAR 10042. KVA    PF:   .95  LAGGING
LOSSES THRU FEEDER:       31. KW      42. KVAR     52. KVA


==== BUS: 1900 TWRS #1    DESIGN VOLTAGE: 13800  BUS VOLTAGE: 13829 %VD:  -.2
========================= PU BUS VOLTAGE:   1.00        ANGLE: -10.5 DEGREES
              NET BRANCH DIVERSITY LOAD:   9500. KW   3122. KVAR

LOAD FROM: 1800 8TH STREET   FEEDER AMPS:   417 VOLTAGE DROP:   59. %VD:   .4
PROJECTED POWER FLOW:  9500. KW  3123. KVAR 10000. KVA    PF:   .95  LAGGING
LOSSES THRU FEEDER:       31. KW      42. KVAR     52. KVA
```

```
                BALANCED VOLTAGE DROP AND LOAD FLOW ANALYSIS
******************************************************************************
VOLTAGE EFFECT ON LOADS MODELED
VOLTAGE DROP CRITERIA: BRANCH =  4.00 %   BUS =  5.00


==== BUS: 2000 NEW2 RISER DESIGN VOLTAGE: 13800  BUS VOLTAGE: 14340 %VD: -3.9
========================= PU BUS VOLTAGE:   1.04        ANGLE:  -9.1 DEGREES

LOAD FROM:    20 C8XNEW2      FEEDER AMPS:   418 VOLTAGE DROP:     5. %VD:    .0
PROJECTED POWER FLOW:  9767. KW  3492. KVAR 10372. KVA    PF:    .94   LAGGING
LOSSES THRU FEEDER:       2. KW        5. KVAR        6. KVA

LOAD   TO: 2800 8TH STREET   FEEDER AMPS:   418 VOLTAGE DROP:   455. %VD:   3.3
PROJECTED POWER FLOW:  9767. KW  3492. KVAR 10372. KVA    PF:    .94   LAGGING
LOSSES THRU FEEDER:     236. KW      327. KVAR      403. KVA


==== BUS: 2800 8TH STREET DESIGN VOLTAGE: 13800  BUS VOLTAGE: 13885 %VD:   -.6
========================= PU BUS VOLTAGE:   1.01        ANGLE: -10.4 DEGREES

LOAD FROM: 2000 NEW2 RISER   FEEDER AMPS:   418 VOLTAGE DROP:   455. %VD:   3.3
PROJECTED POWER FLOW:  9531. KW  3165. KVAR 10043. KVA    PF:    .95   LAGGING
LOSSES THRU FEEDER:     236. KW      327. KVAR      403. KVA

LOAD   TO: 2900 TWRS #1      FEEDER AMPS:   418 VOLTAGE DROP:    59. %VD:    .4
PROJECTED POWER FLOW:  9531. KW  3165. KVAR 10043. KVA    PF:    .95   LAGGING
LOSSES THRU FEEDER:      31. KW       42. KVAR       52. KVA


==== BUS: 2900 TWRS #1    DESIGN VOLTAGE: 13800  BUS VOLTAGE: 13826 %VD:   -.2
========================= PU BUS VOLTAGE:   1.00        ANGLE: -10.5 DEGREES
               NET BRANCH DIVERSITY LOAD:   9500. KW   3122. KVAR

LOAD FROM: 2800 8TH STREET   FEEDER AMPS:   418 VOLTAGE DROP:    59. %VD:    .4
PROJECTED POWER FLOW:  9500. KW  3123. KVAR 10000. KVA    PF:    .95   LAGGING
LOSSES THRU FEEDER:      31. KW       42. KVAR       52. KVA


==== BUS: 3000 NEW3 RISER DESIGN VOLTAGE: 13800  BUS VOLTAGE: 14343 %VD: -3.9
========================= PU BUS VOLTAGE:   1.04        ANGLE:  -9.0 DEGREES

LOAD FROM:    30 C8XNEW3      FEEDER AMPS:   417 VOLTAGE DROP:     5. %VD:    .0
PROJECTED POWER FLOW:  9766. KW  3492. KVAR 10372. KVA    PF:    .94   LAGGING
LOSSES THRU FEEDER:       2. KW        5. KVAR        6. KVA

LOAD   TO: 3800 8TH STREET   FEEDER AMPS:   417 VOLTAGE DROP:   455. %VD:   3.3
PROJECTED POWER FLOW:  9766. KW  3492. KVAR 10372. KVA    PF:    .94   LAGGING
LOSSES THRU FEEDER:     236. KW      326. KVAR      403. KVA
```

```
                BALANCED VOLTAGE DROP AND LOAD FLOW ANALYSIS
******************************************************************************
VOLTAGE EFFECT ON LOADS MODELED
VOLTAGE DROP CRITERIA: BRANCH =  4.00 %   BUS =  5.00


==== BUS: 3800 8TH STREET DESIGN VOLTAGE: 13800  BUS VOLTAGE: 13888 %VD:  -.6
========================= PU BUS VOLTAGE:   1.01        ANGLE: -10.3 DEGREES

LOAD FROM: 3000 NEW3 RISER   FEEDER AMPS:   417 VOLTAGE DROP:  455. %VD:  3.3
PROJECTED POWER FLOW:  9531. KW  3165. KVAR 10042. KVA    PF:   .95   LAGGING
LOSSES THRU FEEDER:      236. KW     326. KVAR     403. KVA

LOAD   TO: 3900 TWRS #2      FEEDER AMPS:   417 VOLTAGE DROP:   59. %VD:   .4
PROJECTED POWER FLOW:  9531. KW  3165. KVAR 10042. KVA    PF:   .95   LAGGING
LOSSES THRU FEEDER:       31. KW      42. KVAR      52. KVA


==== BUS: 3900 TWRS #2    DESIGN VOLTAGE: 13800  BUS VOLTAGE: 13829 %VD:  -.2
========================= PU BUS VOLTAGE:   1.00        ANGLE: -10.5 DEGREES
              NET BRANCH DIVERSITY LOAD:   9500. KW   3122. KVAR

LOAD FROM: 3800 8TH STREET   FEEDER AMPS:   417 VOLTAGE DROP:   59. %VD:   .4
PROJECTED POWER FLOW:  9500. KW  3123. KVAR 10000. KVA    PF:   .95   LAGGING
LOSSES THRU FEEDER:       31. KW      42. KVAR      52. KVA


==== BUS: 4000 NEW4 RISER DESIGN VOLTAGE: 13800  BUS VOLTAGE: 14340 %VD: -3.9
========================= PU BUS VOLTAGE:   1.04        ANGLE:  -9.1 DEGREES

LOAD FROM:   40 C8XNEW4      FEEDER AMPS:   418 VOLTAGE DROP:    5. %VD:   .0
PROJECTED POWER FLOW:  9767. KW  3492. KVAR 10372. KVA    PF:   .94   LAGGING
LOSSES THRU FEEDER:        2. KW       5. KVAR       6. KVA

LOAD   TO: 4800 8TH STREET   FEEDER AMPS:   418 VOLTAGE DROP:  455. %VD:  3.3
PROJECTED POWER FLOW:  9767. KW  3492. KVAR 10372. KVA    PF:   .94   LAGGING
LOSSES THRU FEEDER:      236. KW     327. KVAR     403. KVA


==== BUS: 4800 8TH STREET DESIGN VOLTAGE: 13800  BUS VOLTAGE: 13885 %VD:  -.6
========================= PU BUS VOLTAGE:   1.01        ANGLE: -10.4 DEGREES

LOAD FROM: 4000 NEW4 RISER   FEEDER AMPS:   418 VOLTAGE DROP:  455. %VD:  3.3
PROJECTED POWER FLOW:  9531. KW  3165. KVAR 10043. KVA    PF:   .95   LAGGING
LOSSES THRU FEEDER:      236. KW     327. KVAR     403. KVA

LOAD   TO: 4900 TWRS #2      FEEDER AMPS:   418 VOLTAGE DROP:   59. %VD:   .4
PROJECTED POWER FLOW:  9531. KW  3165. KVAR 10043. KVA    PF:   .95   LAGGING
LOSSES THRU FEEDER:       31. KW      42. KVAR      52. KVA
```

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                BALANCED VOLTAGE DROP AND LOAD FLOW ANALYSIS
*****************************************************************************
VOLTAGE EFFECT ON LOADS MODELED
VOLTAGE DROP CRITERIA: BRANCH =  4.00 %   BUS =  5.00


==== BUS: 4900 TWRS #2    DESIGN VOLTAGE: 13800  BUS VOLTAGE: 13826 %VD:  -.2
======================== PU BUS VOLTAGE:    1.00        ANGLE: -10.5 DEGREES
               NET BRANCH DIVERSITY LOAD:   9500. KW   3122. KVAR

LOAD FROM: 4800 8TH STREET   FEEDER AMPS:   418 VOLTAGE DROP:   59. %VD:   .4
PROJECTED POWER FLOW:  9500. KW  3123. KVAR 10000. KVA    PF:   .95   LAGGING
LOSSES THRU FEEDER:       31. KW       42. KVAR      52. KVA


==== BUS: 8999 ZIGZAG #2  DESIGN VOLTAGE: 13800  BUS VOLTAGE: 14348 %VD: -4.0
======================== PU BUS VOLTAGE:    1.04        ANGLE:  -9.0 DEGREES
**** NO LOAD SPECIFIED ****


==== BUS: 9999 ZIGZAG #1  DESIGN VOLTAGE: 13800  BUS VOLTAGE: 14351 %VD: -4.0
======================== PU BUS VOLTAGE:    1.04        ANGLE:  -9.0 DEGREES
**** NO LOAD SPECIFIED ****
```

BALANCED VOLTAGE DROP AND LOAD FLOW BUS DATA SUMMARY
****

BUS#	NAME	BASE VOLT	PU VOLT	BUS#	NAME	BASE VOLT	PU VOLT
1	A8 BUS 1	13800.00	1.0397	2	A8 BUS 2	13800.00	1.0395
10	C8XNEW1	13800.00	1.0397	20	C8XNEW2	13800.00	1.0395
30	C8XNEW3	13800.00	1.0397	40	C8XNEW4	13800.00	1.0395
100	A2702C SEC	13800.00	1.0399	200	A2703C SEC	13800.00	1.0397
234	BPA	234400.00	.9905	1000	NEW1 RISER	13800.00	1.0393
1800	8TH STREET	13800.00	1.0064	1900	TWRS #1	13800.00	1.0021
2000	NEW2 RISER	13800.00	1.0392	2800	8TH STREET	13800.00	1.0062
2900	TWRS #1	13800.00	1.0019	3000	NEW3 RISER	13800.00	1.0393
3800	8TH STREET	13800.00	1.0064	3900	TWRS #2	13800.00	1.0021
4000	NEW4 RISER	13800.00	1.0392	4800	8TH STREET	13800.00	1.0062
4900	TWRS #2	13800.00	1.0019	8999	ZIGZAG #2	13800.00	1.0397

BALANCED VOLTAGE DROP AND LOAD FLOW BRANCH DATA SUMMARY
****

FROM	NAME	TO	NAME	TYPE	VD%	AMPS	KVA	RATING%
1	A8 BUS 1	10	C8XNEW1	FDR	.00	417.49	10375.52	69.58
1	A8 BUS 1	30	C8XNEW3	FDR	.00	417.49	10375.51	69.58
1	A8 BUS 1	100	A2702C SEC	FDR	.02	1529.51	38011.05	72.83
2	A8 BUS 2	20	C8XNEW2	FDR	.00	417.58	10375.67	69.60
2	A8 BUS 2	40	C8XNEW4	FDR	.00	417.58	10375.67	69.60
2	A8 BUS 2	200	A2703C SEC	FDR	.02	1529.80	38011.35	72.85
10	C8XNEW1	1	A8 BUS 1	FDR	.00	417.49	10375.48	69.58
10	C8XNEW1	1000	NEW1 RISER	FDR	.04	417.49	10375.48	69.58
20	C8XNEW2	2	A8 BUS 2	FDR	.00	417.58	10375.63	69.60
20	C8XNEW2	2000	NEW2 RISER	FDR	.04	417.58	10375.63	69.60
30	C8XNEW3	1	A8 BUS 1	FDR	.00	417.49	10375.48	69.58
30	C8XNEW3	3000	NEW3 RISER	FDR	.04	417.49	10375.48	69.58
40	C8XNEW4	2	A8 BUS 2	FDR	.00	417.58	10375.63	69.60
40	C8XNEW4	4000	NEW4 RISER	FDR	.04	417.58	10375.63	69.60
100	A2702C SEC	1	A8 BUS 1	FDR	.02	1529.51	38018.30	72.83
100	A2702C SEC	234	BPA	TX2	-4.94	1529.51	38018.30	76.04
100	A2702C SEC	9999	ZIGZAG #1	TX2	.00	.00	.00	.00
200	A2703C SEC	2	A8 BUS 2	FDR	.02	1529.80	38018.61	72.85
200	A2703C SEC	234	BPA	TX2	-4.92	1529.80	38018.61	76.04
200	A2703C SEC	8999	ZIGZAG #2	TX2	.00	.00	.00	.00
234	BPA	100	A2702C SEC	TX2	-4.94	100.99	40612.00	81.22
234	BPA	200	A2703C SEC	TX2	-4.92	101.01	40619.83	81.24
1000	NEW1 RISER	10	C8XNEW1	FDR	.04	417.49	10371.75	69.58
1000	NEW1 RISER	1800	8TH STREET	FDR	3.30	417.49	10371.75	69.58
1800	8TH STREET	1000	NEW1 RISER	FDR	3.30	417.49	10042.49	69.58

BALANCED VOLTAGE DROP AND LOAD FLOW BRANCH DATA SUMMARY
****

FROM	NAME	TO	NAME	TYPE	VD%	AMPS	KVA	RATING%
1800	8TH STREET	1900	TWRS #1	FDR	.43	417.49	10042.49	69.58
1900	TWRS #1	1800	8TH STREET	FDR	.43	417.49	10000.04	69.58
2000	NEW2 RISER	20	C8XNEW2	FDR	.04	417.58	10371.89	69.60
2000	NEW2 RISER	2800	8TH STREET	FDR	3.30	417.58	10371.89	69.60
2800	8TH STREET	2000	NEW2 RISER	FDR	3.30	417.58	10042.51	69.60
2800	8TH STREET	2900	TWRS #1	FDR	.43	417.58	10042.51	69.60
2900	TWRS #1	2800	8TH STREET	FDR	.43	417.58	10000.04	69.60
3000	NEW3 RISER	30	C8XNEW3	FDR	.04	417.49	10371.74	69.58
3000	NEW3 RISER	3800	8TH STREET	FDR	3.30	417.49	10371.74	69.58
3800	8TH STREET	3000	NEW3 RISER	FDR	3.30	417.49	10042.49	69.58
3800	8TH STREET	3900	TWRS #2	FDR	.43	417.49	10042.49	69.58
3900	TWRS #2	3800	8TH STREET	FDR	.43	417.49	10000.04	69.58
4000	NEW4 RISER	40	C8XNEW4	FDR	.04	417.58	10371.89	69.60
4000	NEW4 RISER	4800	8TH STREET	FDR	3.30	417.58	10371.89	69.60
4800	8TH STREET	4000	NEW4 RISER	FDR	3.30	417.58	10042.51	69.60
4800	8TH STREET	4900	TWRS #2	FDR	.43	417.58	10042.51	69.60
4900	TWRS #2	4800	8TH STREET	FDR	.43	417.58	10000.04	69.60
8999	ZIGZAG #2	200	A2703C SEC	TX2	.00	.00	.00	.00
9999	ZIGZAG #1	100	A2702C SEC	TX2	.00	.00	.00	.00

NOTE: FOR FEEDERS, RATING% = LOAD FLOW AMPS / FLA.
FLA = LIBRARY FLA EXCLUDING DUCT BANK AND TEMP. DERATING FOR CABLES.
FLA = BRANCH RECORD INPUT FLA FOR IMPEDANCE DATA.

NOTE: FOR TRANSFORMERS, RATING% = LOAD FLOW KVA / TRANSFORMER FULL LOAD KVA.

23 BUSES

*** T O T A L   S Y S T E M   L O S S E S ***
1595. KW   15261. KVAR

APPENDIX C

ALTERNATIVES 2 AND 3 BONNEVILLE POWER ADMINISTRATION LOAD FLOW CALCULATIONS

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APPENDIX C

ALTERNATIVES 2 AND 3 BONNEVILLE POWER ADMINISTRATION LOAD FLOW CALCULATIONS

C1.0 ALTERNATIVE 2--BONNEVILLE POWER ADMINISTRATION 115 kV TRANSMISSION SYSTEM

This alternative includes the construction of a new 115 kV substation and approximately 22.5 km (14 mi) of 115 kV transmission line. The new 115 kV substation would be located in the 200 Area, close to the privatization facilities. A new 115 kV transmission line, approximately 4.8 km (3 mi) long, would be extended from the Midway-Benton loop at Eagle Point to the new substation. A second new 115 kV transmission line, approximately 17.7 km (11 mi) long, would be extended from the 451-B Substation, located at 400 Area, to the new substation. Modifications at the 451-B Substation would be necessary to extend a new 115 kV transmission line from the 451-B Substation to the new substation. Sketch 5 of this Appendix, page C-9, illustrates the proposed routing and system oneline for this alternative. Several loading scenarios were evaluated by the BPA under this alternative. The preliminary BPA studies attached to this Appendix.

C2.0 ALTERNATIVE 3 DESCRIPTION--RL 230 kV TRANSMISSION SYSTEM

This alternative includes the construction of a new 230 kV substation and approximately 6.4 km (4 mi) of 230 kV transmission line. The new 230 kV substation would be located in the 200 Area, close to the privatization facilities. The new 230 kV transmission lines would be tapped into the existing RL 230 kV transmission system. Sketch on page 10 of this Appendix, illustrates the proposed routing and system oneline for this alternative. Several loading scenarios were evaluated by the BPA under this alternative. Several studies were performed with the addition of a 100 MVAR capacitor bank located at the BPA Ashe Substation. The capacitor bank will be needed to ensure that the BPA maintains the service voltage at 234.4 kV or above as required per the BPA contract with the WNP #2 Facility.

C3.0 SYSTEM MODELING AND LOAD FLOW CALCULATIONS

All load flow calculations for the 115 kV and 230 kV systems were performed by the BPA.

- Existing 200 Area forecasted loads shall be used to ensure other programs and facilities are not impacted by the additional load brought on by the privatized facilities. The 251-W Substation was modeled with 34 MW base load. This base load was considered to be the forecasted load for all non-TWRS Phase I privatized facilities for 2003.

- The total load for the privatized facilities was estimated at 40 and 60 MW.

- The 230 kV system voltage at the WNP #2 Facility must not be lower than 234.4 kV. 234.4 kV is the regulatory requirement BPA must meet at the WNP #2 start-up transformers, located near the Ashe Substation.

C4.0 MODELING DATA

All modeling data are based upon BPA records.

COPY

TWRS Project

Preliminary Engineering Report

For Electrical Service

Submittal to Gurdhian Singh (WHC)

by Earl Brown (BPA)

for meeting 1/30/96

Comparison of 230 kV and 115 kV Plans with Pros and Cons

I. 230 kV Plan

Pros

1. Reliability
   Liklihood of an interruption with this plan is ten times less probable than with the 115 kV plan.
2. Environmental Impact
   Less impact with this plan with 4 miles of transmission line versus 14 miles of 115 kV line.
3. Cost
   a. Less costly plan with
      1. Tap line costs estimated $1.66 million
      2. Substation costs estimated $5.2 million *

   *Estimate does not include the station bypass switches and bus, nor 13.8 kV control house and equipment. Transfer trip equipment at the station is include, but communication equipment remote from station is not included.
4. Less Losses
   Losses are negligible with this plan compared to 115 kV plan
5. Longevity

Cons

1. Speed up of the 230 kV, 100 MVAR capacitor group at Ashe substation. BPA would probably include in their network transmission costs.
   a. Required to meet the regulatory requirements for the WNP2 plant.
   b. Also maintain the voltage for all single contingency outages.

II. 115 kV Plan

Pros

1. Improvements outside the scope of this project not immediately required, (improvements at 451B considered directly connected with this project).

Cons

1. Environmental impact is greater than 230 kV plan with 14 miles of transmission line to construct versus 4 miles with the 230 kV plan.

2. Cost is greater
   a. Tap lines cost is estimated at $3.5 million
   b. Substation costs estimated at $3.15 million*
   *Estimate does not include the station bypass switches and bus, nor 13.8 kV control house and equipment. No transfer trip equipment or communication equipment is included in this estimate, although as a minimum, transfer trip is required for three terminal operation of the Midway-Benton 115 kV line.
   c. Construction of a bay at 451B substation with two 115 kV breakers will cost an additional $2 million.

3. Environmental impact is greater with 14 miles of transmission line to construct.

4. Losses are higher with this plan and may require 115 kV metering at the Midway - Benton Tap and at 451B substation.

5. Reliability
   Interruption of service is 10 times more probable from last five year study period (see attached sheet).

1. Interruptions to Service the last Five Years with the 230 kV Plan.

The Midway-251W-Ashe No. 2 230 KV line has has three momentary relay operations in the last five years. They occurred:

June 29, 1991 at 1508 Hrs lightning caused
November 9, 1993 at 923 Hrs human element caused
May 27, 1995 at 1257 Hrs cause unknown

None of these automatic line outages would have caused an outage to the Vitrification Plant substation other than momentary loss of loop feed.

The 230 kV north loop line No.1 has had four relay operations in the last five years. Two of them human element caused. This line is primarily for reliability of the loop feed.

The four miles of additional tap line adds eleven percent to the line length studied with this plan, and would not contribute to the number of outages these lines experience of any significance.

2. Interruptions to Service the last Five Years with the 115 kV Plan

The Midway-Benton No.1 115 kV line has had twenty-one automatic interruptions with a cumulative outage time of seven hours nine minutes. Seventeen were momentary outages.

The Benton-451B 115 kV line has had four automatic outages with three momentary, and the fourth outage lasting 2hr 21 min. The 451B-White Bluffs 115 kV line has had five automatic outages with two momentary and a cumulative outage time of 22 hours and 20 minutes. None of the outages of these two lines were coincidental to cause a station outage at 451B.

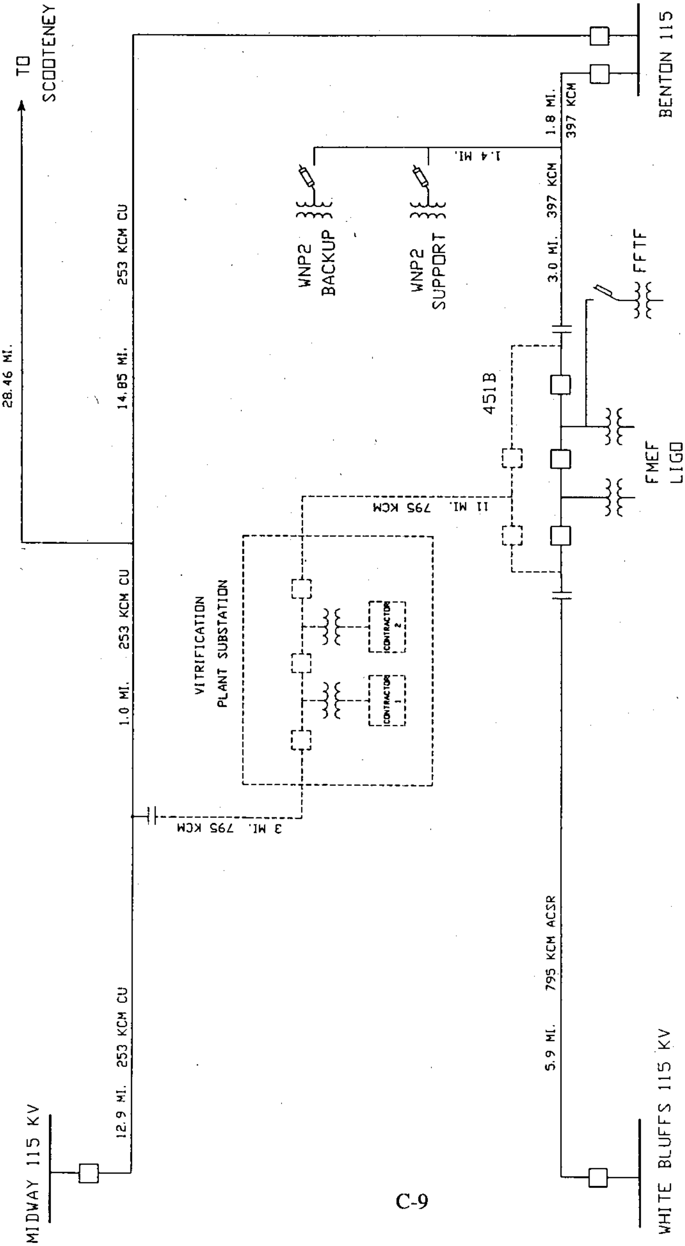
Even though it would require construction of eleven or more miles of 115 kV transmission line the most reliable source would be from 451B rather than the three mile tap on the Midway-Benton line with over sixty miles of line exposure.

The probability of interruption of the eleven miles of line from the 451B station to the vitrification plant substation is between one and two outages per year.

Comparison of Probable Availability of the 230 kV Plan versus the 115 kV Plan

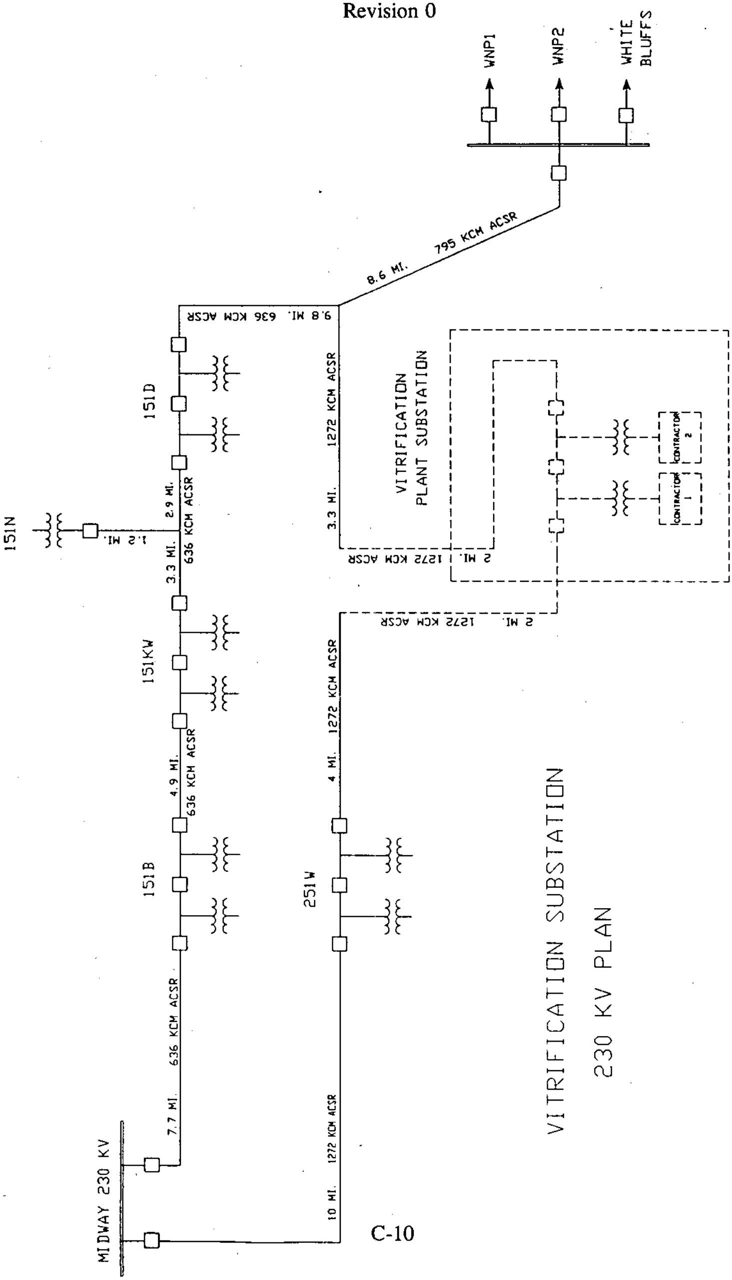
Both vitrification substations could operate for years without an outage, but the ratio of outages occurring on the transmission lines that would serve the stations, of .6 to 6 means that the likihood of an outage occurring during the study period is ten times higer with the 115 kV plan.

Preliminary 2/13/96



HANFORD VITRIFICATION PLANT SUBSTATION
115 KV PLAN

Preliminary 2/13/96



VITRIFICATION SUBSTATION
230 KV PLAN

Preliminary 2/13/96

ESTIMATE SUMMARY

TITLE :
DOE RICHLAND'S A8-ASHE TAP 230 KV LINE
LOOP TO THE VITRIFICATION PLANT SUBSTATION

ESTIMATE NO.	FT-1518-GU
EST. TYPE	PRELIM. REIMBURSABLE
REQUESTED BY	BROWN - TECE/WA
BI / CPA NO.	
PAR NO.	
EST REQST NO.	. (L-5008)
SYS PD NO.	REV # :
CTL PD NO.	REV # :

DESCRIPTION :
LOOP DOE RICHLAND'S A8-ASHE TAP 230 KV LINE INTO THE VITRIFICATION PLANT SUBSTATION. THE LOOP WILL CONSIST OF 4 MILES OF SINGLE CIRCUIT 230 KV LATTICE STEEL LINE AND WILL TAP THE A8-RICHLAND LINE APPROXIMATELY 4 MILES EAST OF A8 (251W) SUBSTATION.

NOTES:
1. THIS ESTIMATE DOES NOT INCLUDE THE COST OF LAND AND ENVIRONMENTAL ANALYSIS.

LOOP LENGTH	-4 MILES (SGL.CIR.)
STRUCTURES	-S.C LATTICE STEEL
CONDUCTOR	-ACSR "BITTERN" - 1272 MCM
VOLTAGE	-230 KV
RIGHT OF WAY	-NEW

Preliminary 2/13/96

FUNCTION	CONTRACT	BPA	TOTAL
OTHER			
PLANS/STUDIES			
ENVIRONMENT			
SURVEY	68690	20200	88890
DESIGN		34280	34280
LAND ( )			
MATERIAL		535050	535050
CONSTRUCTION	558860	59460	618320
RETIREMENT			
		SUBTOTAL	1276540
	INDIRECT O.H. - 30 %	& ROUNDOUT	383460
	MS&A-G&A O.H. -	0 %	

GROSS COST	1660000	GROSS COST	1660000
LESS SALVAGE		LESS SYS. MAT.	
NET COST	1660000	BUDGET COST	1660000

		DATE
GENERAL		
SAVEFILE:	ID:471	26-JAN-96
PROJECT : EST471		
PREPARED		
V. SHAW		26-JAN-96
SUBMITTED		
APPROVED		
Bick		1-26-96
APP. PLAN SRV.		

ESTIMATE DETAIL(S) NOTE:
* = SPECIAL (NON-CATALOG) ITEM
** = CATALOG ADJUSTMENT % APPLIED TO NORMAL ITEM COST

ESTIMATE DATE AND TIME STAMPS:

$ MODIFIED	26-JAN-96	12.20 PM
CALCULATED	26-JAN-96	12.21 PM
PRINTED	26-JAN-96	12.21 PM
TRANSMITTED		

1993 TYPICAL MILE TRANSMISSION LINE ESTIMATES

(LAND, INDIRECT OVERHEADS, AND ENVIRONMENTAL COSTS NOT INCLUDED)

230 KV

CONDUCTOR		SINGLE CIRCUIT			DOUBLE CIRCUIT			
		ROLLING TERRAIN		50-50 TERRAIN	ROLLING TERRAIN			50-50 TERRAIN
MCM	NAME	H-FRAME WOOD	LATTICE STEEL	LATTICE STEEL	H-FRAME WOOD	SINGLE STEEL POLE	LATTICE STEEL	LATTICE STEEL
795	AAC,BAKER	$133,080						
954	AAC,RAINIER	$137,100						
993	ACSR,CLACKAMAS		$172,220	$212,250			$285,390	$333,200
1114	ACSR,ROGUE		$176,980	$217,320		$310,480	$293,840	$342,360
1137	AAC,HELENS	$144,730						
1509	ACSR,DESCHUTES		$229,000	$261,860			$344,200	$376,160
1589	AAC,HOOD	$159,830			$236,240	$358,670		
1917	ACSR,UMPQUA		$235,960	$268,720			$357,690	$389,650
1979	AAC,BACHELOR	$174,230						
2406	AAC,JEFFERSON	$187,480	$252,830	$285,250			$382,570	$415,210

DIVISION OF FACILITIES ENGINEERING
PROGRAM MANAGEMENT SEC.-EFCH
DECEMBER 1993 2 OF 3

1993 TYPICAL MILE TRANSMISSION LINE ESTIMATES

(LAND, INDIRECT OVERHEADS, AND ENVIRONMENTAL COSTS NOT INCLUDED)

115 KV

CONDUCTOR MCM	CONDUCTOR NAME	SINGLE CIRCUIT – ROLLING TERRAIN – WOOD POLE – SINGLE POLE	SINGLE CIRCUIT – ROLLING TERRAIN – WOOD POLE – H-FRAME	SINGLE CIRCUIT – ROLLING TERRAIN – STEEL POLE – SINGLE POLE	SINGLE CIRCUIT – 50-50 TERRAIN – LATTICE STEEL – SELF-SUPPORTING	DOUBLE CIRCUIT – 50-50 TERRAIN – LATTICE STEEL – SELF-SUPPORTING
398	ACSR,IBIS	$109,900				
795	AAC,BAKER	$119,740	$124,490			
795	ACSR,DRAKE				$191,720	$262,730
795	ACSR,TOUTLE			$140,000		
954	AAC,RAINIER		$128,810			
1137	AAC,HELENS	$133,260	$135,200			
1589	ACC,HOOD	$151,500	$149,520			
1979	AAC,BACHELOR		$164,260			
2406	AAC,JEFFERSON		$176,250			

TMDS FILE NAME: ETCPAS

DIVISION OF FACILITIES ENGINEERING
PROGRAM MANAGEMENT SEC.–EFCH
DECEMBER 1993 1 OF 3

Transmission Line Ratings for Service to the Hanford Waste Vitrification Project

Name	Conductor	Max Temp	Winter Rating	Summer Rating
Midway-A2(151B) 230 kV	636 ACSR Egret	50	930	440
Midway-Benton 230 kV	636 ACSR Egret	100	1210	930
Midway-A8(251W) 230 kV	1272 ACSR Bittern	50	1400	640
A8(251W)-Ashe Tap 230 kV	1272 ACSR Bittern	50	1400	640
Ashe-Ashe Tap 230 kV	795 ACSR Drake	90	1330	990
Ashe-White Bluffs 230 kV	795 ACSR Drake	100	1380	1070
Midway-Benton 115 kV	253 Cu	80	780	550
Benton-451B 115 kV	397.5 ACSR Ibis	90	850	640
Benton-B3S4-White Bluffs 115 kV	250 Cu	100	790	590

Note:
1. Summer Rating at 30 degrees C ambient
2. Winter Rating at -15 degrees C ambient
3. maximum conductor temp of 50 degrees C assumed for non-BPA lines

TECHNICAL NOTES

"Point of Delivery" as the Unit of Analysis BPA Reliability Criteria for Service Continuity

The principal unit of analysis for this report is the ***"Point-of-Delivery"*** (POD). A POD is defined in the BPA Reliability Criteria and Standards (Sept. 1991, page I-A-2) as a:

> "point at which utility systems are connected with the primary purpose of one-way power delivery."

These same Criteria (page I-D-3.2) identify BPA's "Service Continuity Standard" as follows:

> "BPA will plan, design, operate, and maintain its transmission system in a manner that assures maximum practicable service continuity to the ultimate consumer. BPA will strive to maintain a goal of not more than 2-1/2 hours (150 minutes) cumulative annual outage time for each direct-service or transfer ***point-of-delivery.***"(emphasis added)

Since the focus of BPA's service continuity standard is the individual POD, this report considers a "customer" to be a grouping of the one or more individual PODs by which that customer is connected to the BPA system. ***This interpretation ensures consistency with the individual POD focus of BPA's service continuity standard.***

Users interested in an overall customer perspective, however, need to be aware of several data limitations. Our present outage data system does not yet provide for the identification of customer outages during which load transferring between PODs may have occurred. In addition, the data system currently maintains no quantitative (MW) measure of actual "load lost" or "load transferred", either for the individual POD, or for the customer overall. Since data do not yet exist to support an overall customer perspective (i.e., considering load lost and load transferring) the POD focus of this report is not only consistent with BPA's Reliability Criteria, but it is the only practicable approach.

Finally, while the BPA Reliability Criteria distinguish between ***"points-of-delivery"*** (primarily one-way power flow) and ***"points-of-interconnection"*** (POI; primarily two-way power flow), our data collection system does not yet fully distinguish between these types of connection points. An effort to sort out POIs from PODs is underway, and many high-voltage POIs have already been excluded. However, for the purposes of this report, remaining connection points are treated as PODs. This is only an issue for the handful of BPA customers with their own generating capacity.

Outage "Cause"

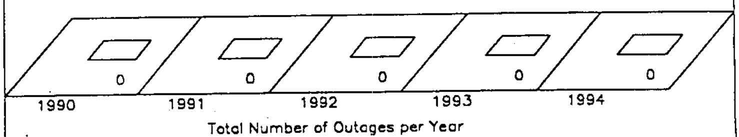
The ***"cause"*** is the operational event or action which triggered the outage (e.g., "tree in line", "lightning", etc.). This code is assigned by the System Dispatching staff before any extensive field research is conducted. As such, it may be the data component most subject to possible error. Future inclusion of field input (see above) is likely to usher in improvements in the accuracy of outage cause recording.

Outage "Origin"

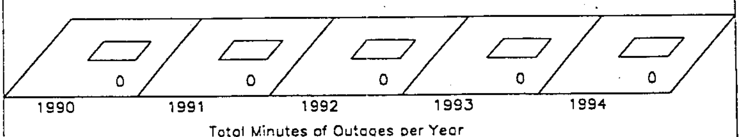
The ***"origin"*** is defined as the "system in control" at the location of the event which triggered the customer/POD outage. The origin may be BPA, a third-party transferor, a customer, or unknown. Many of the analyses in this report draw distinctions based on the ***origin*** of the outage problem. This provides a way to identify outages over which BPA has operational and/or management control. ***Performance Indicators*** (see below) are calculated and reported for "All Automatic Outages" and "Automatic Outages Not of Customer Origin' The first of these analyzes overall performance at the POD(s). The second treats only outages with an origin of "BPA", "Transferor", or "Unknown" as a BPA "responsibility" (i.e., outages with "Customer" as the origin are excluded).

U.S. DEPT. OF ENERGY/RICHLAND
NUMBER AND DURATION OF POD OUTAGES
ALL PODS, COMBINED; 1990–1994, BY YEAR

AUTOMATIC POD OUTAGES
BY NUMBER



AUTOMATIC POD OUTAGES
BY DURATION



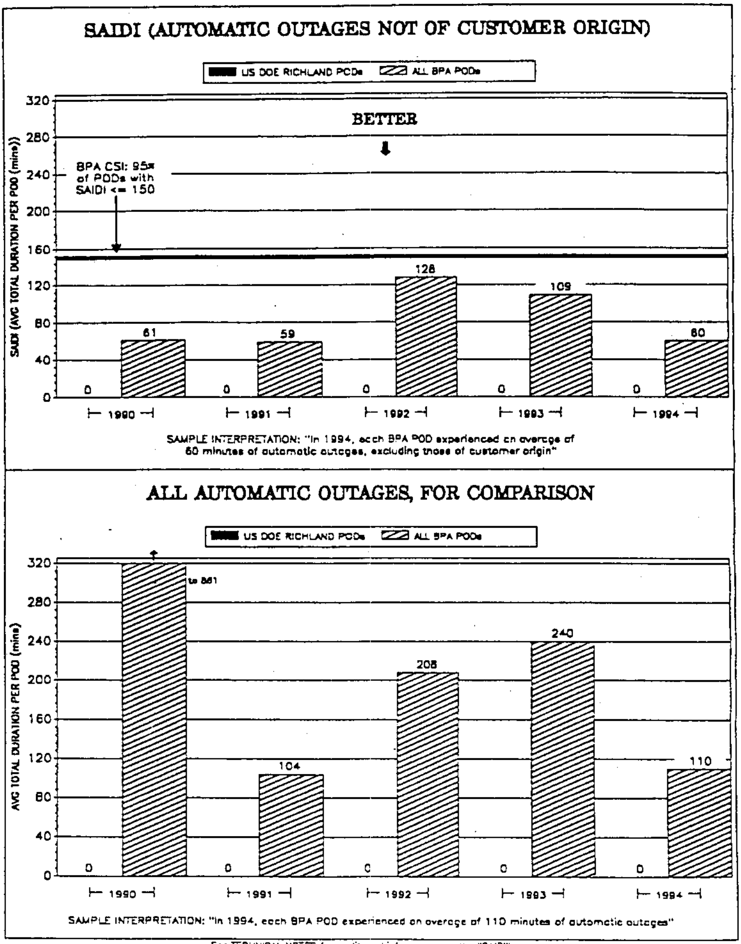
This customer had an average of 6 PODs in 1994

NOTE: 1440 MINS=1 DAY

CPPG1 TOT 21JUL95

PAGE 1 (SE625)

U.S. DEPT. OF ENERGY/RICHLAND
"SAIDI" INDEX; 1990–1994, BY YEAR
(AVERAGE TOTAL DURATION OF AUTOMATIC OUTAGES PER POD)
THIS CUSTOMER'S PODs vs. ALL BPA PODs



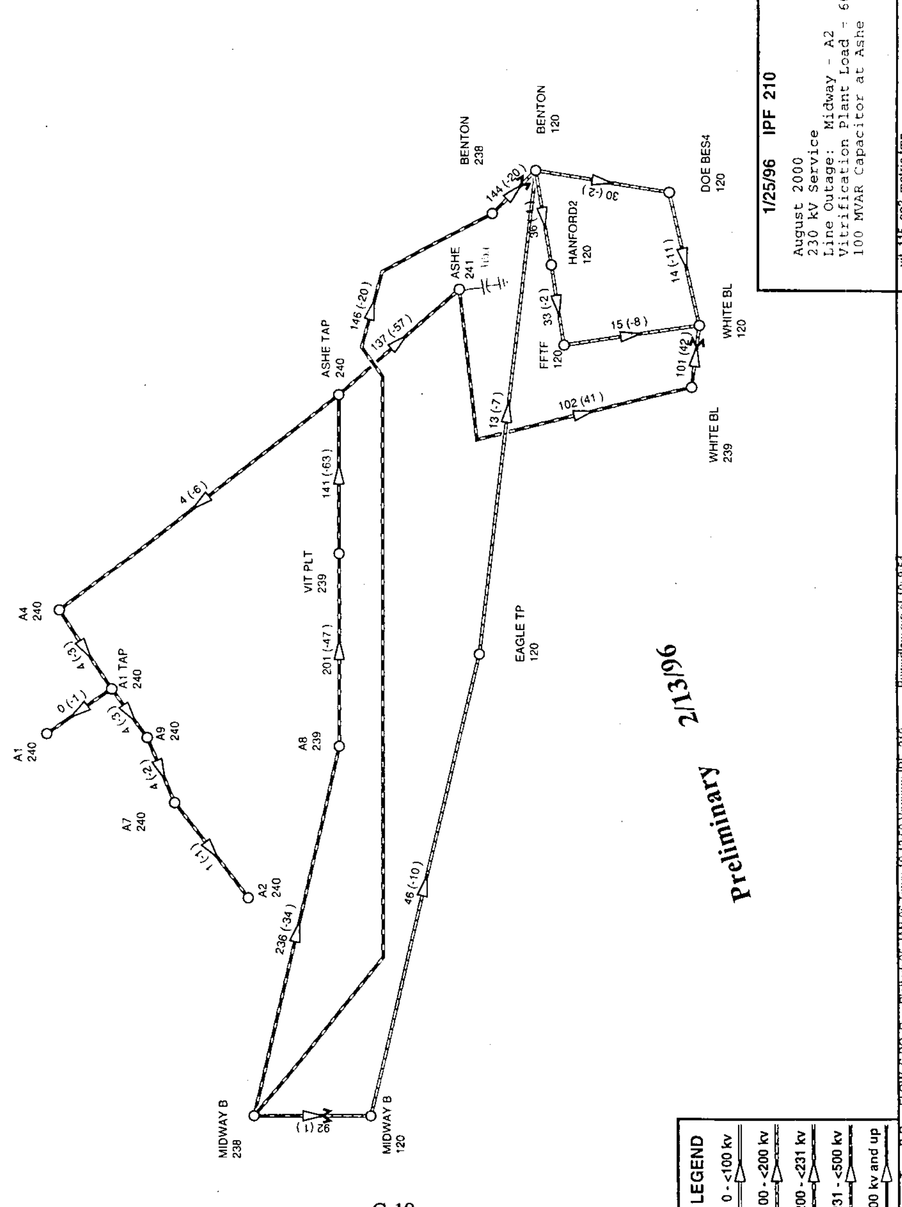
See TECHNICAL NOTES for additional information re. the "SAIDI" index
(System Average Interruption Duration Index) and the BPA Reliability Standard/CSI

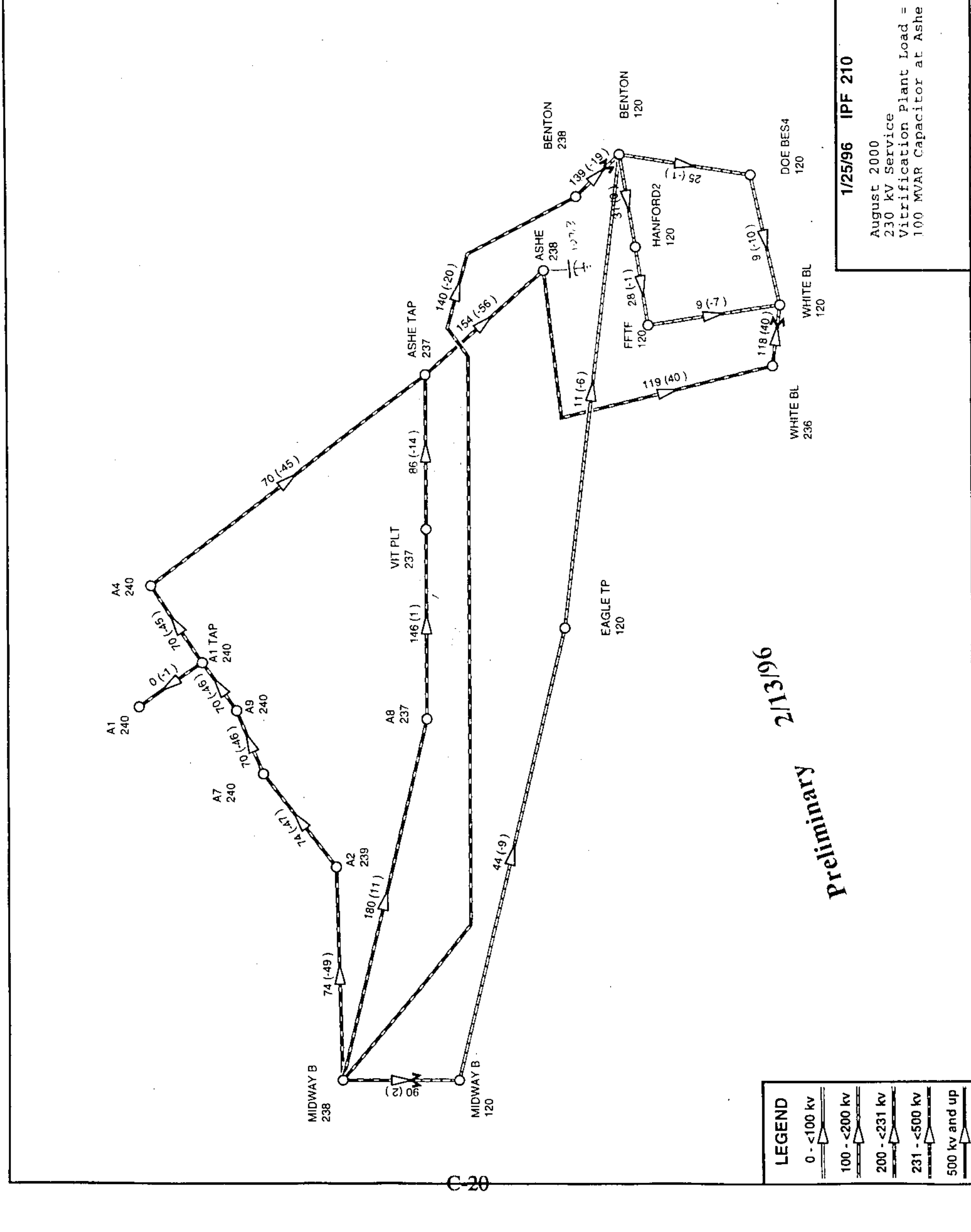
CPPG3 TOT 21JUL95

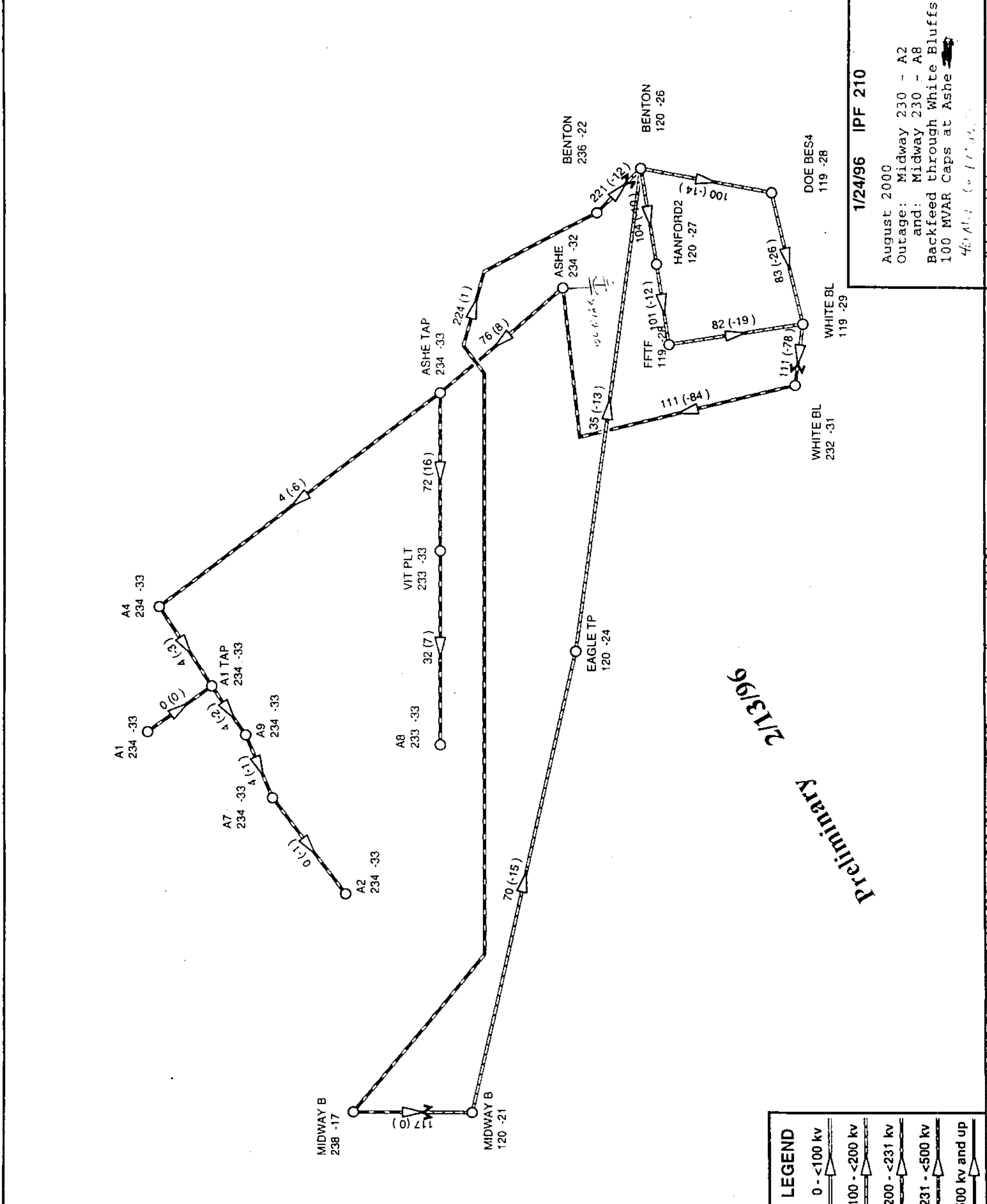
PAGE 3 (SE627)

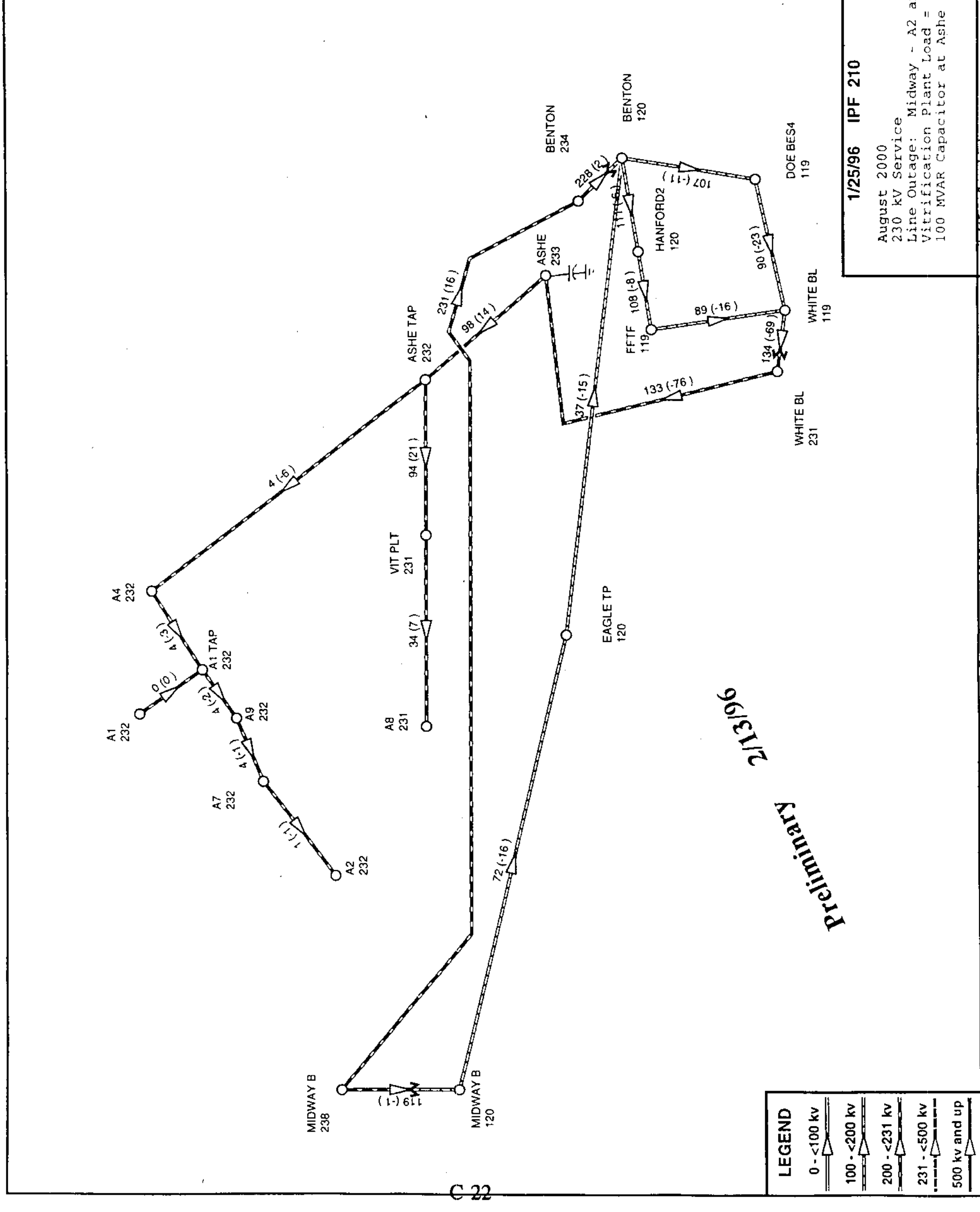
Cases Run for Vitrification Plant Study

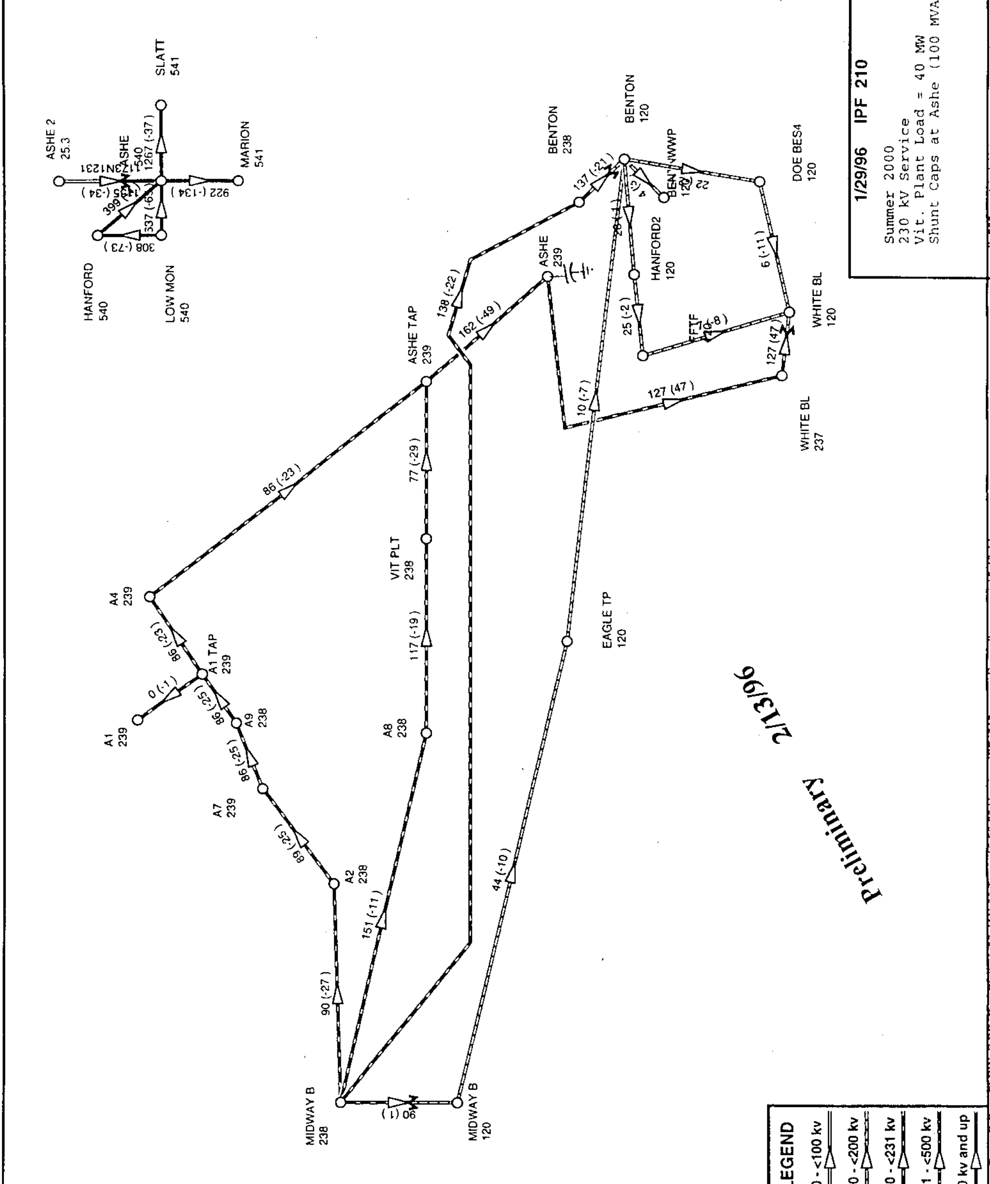
Case Number	Service (kV)	Vitrification Load (MW)	Capacitor Bank at Ashe (MVAR)	Outages
1	230	60	100	Midway - A2
2	230	60	100	None
3	230	40	100	Midway to A2 and A8
4	230	60	100	Midway to A2 and A8
5	230	40	100	None
6	230	40	100	Midway - A8
7	230	40	100	Midway to A2 and A8 and WNP out
8	230	40	0	Midway 230 - A8 and Midway 115 - Benton
9	230	40	0	Midway to A2 and A8
10	115	40	0	None
11	115	60	0	None
12	115	60	0	None
13	115	60	0	Midway - Benton
14	115	60	0	Vitrification Tap - Vitrification Plant Load
15	115	60	0	None
16	115	60	0	Midway 230 - Benton
17	115	60	0	Vitrification Tap - Vitrification Plant Load
18	230	60	0	None
19	230	60	0	Midway - A8
20	230	60	0	Midway to A2 and A8
21	230	60	100	Midway to A2 and A8
22	230	60	0	Midway 230 - Benton

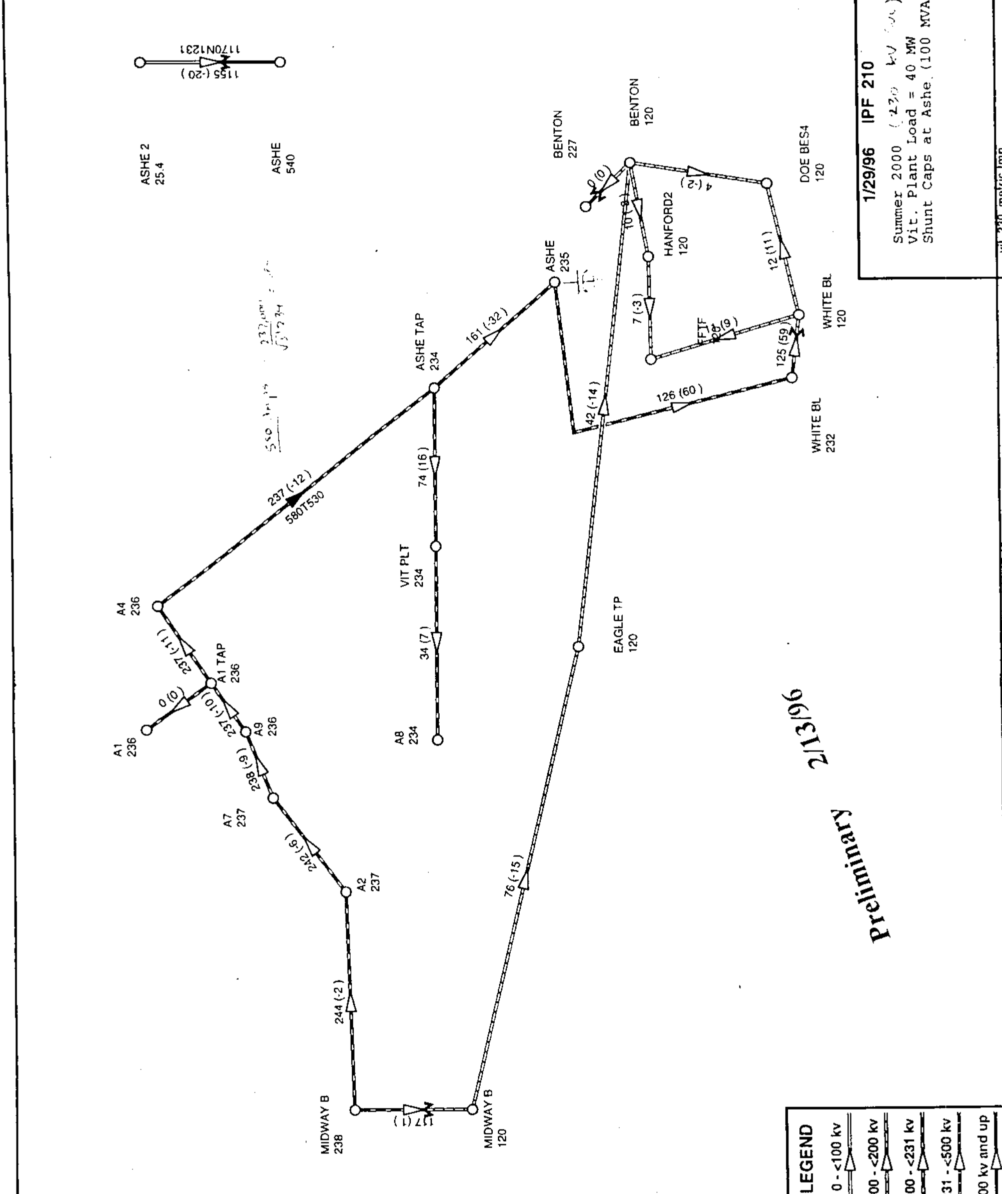

1/25/96 IPF 210
August 2000
230 kV Service
Line Outage: Midway - A2
Vitrification Plant Load - 60MW
100 MVAR Capacitor at Ashe
vit_115_op2_metric.fmp
BENTON 238
BENTON 120
DOE BES4 120
HANFORD2 120
ASHE 241
ASHE TAP 240
FFTF 120
WHITE BL 120
WHITE BL 239
VIT PLT 239
A4 240
A1 TAP 240
A1 240
A9 240
A7 240
A2 240
A8 239
EAGLE TP 120
MIDWAY B 238
MIDWAY B 120
144 (-20)
30 (-2)
36
14 (-11)
146 (-20)
137 (-57)
33 (-2)
15 (-8)
101 (42)
102 (41)
13 (-7)
4 (-6)
141 (-63)
201 (-47)
4 (-3)
0 (-1)
4 (-3)
4 (-2)
1 (-1)
236 (-34)
46 (-10)
92 (1)
2/13/96
Preliminary
LEGEND
0 - <100 kv
100 - <200 kv
200 - <231 kv
231 - <500 kv
500 kv and up
Diagram Type: P-Q FLOW: S,PQ H: Plotted: 25-JAN-96 Time: 10:13:50 Version: IPF 210 Powerflow run at 10:8:54

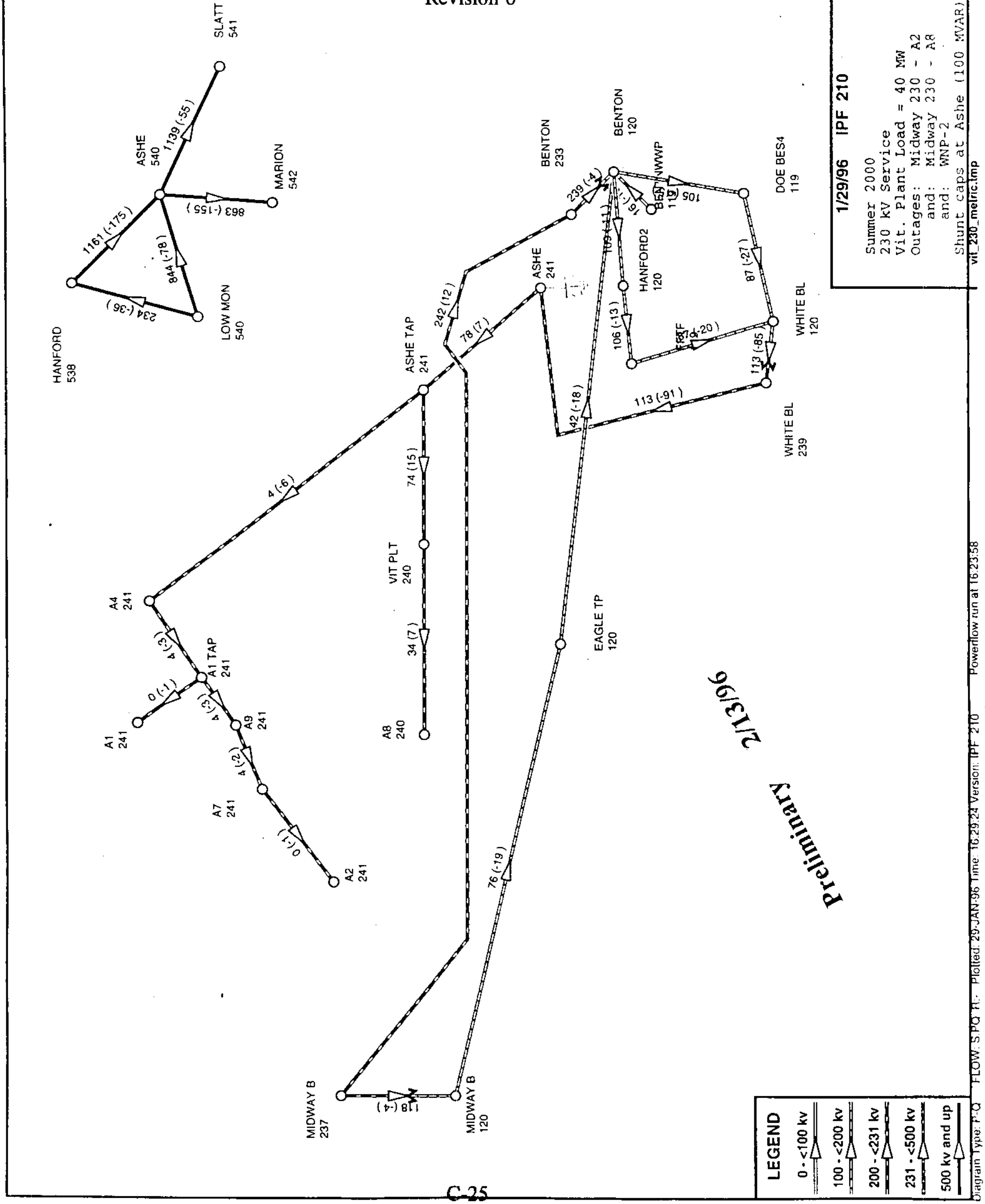

1/25/96 IPF 210
August 2000
230 kV Service
Vitrification Plant Load = 60MW
100 MVAR Capacitor at Ashe
MIDWAY B
238
MIDWAY B
120
90 (2)
74 (-49)
180 (11)
A2
239
74 (-47)
A7
240
70 (-46)
A9
240
70 (-46)
A1
240
0 (-1)
A1 TAP
240
70 (-45)
A4
240
70 (-45)
A8
237
146 (1)
VIT PLT
237
86 (-14)
ASHE TAP
237
154 (-56)
140 (-20)
ASHE
238
139 (-19)
BENTON
238
BENTON
120
25 (-1)
DOE BES4
120
HANFORD2
120
28 (-1)
FFTF
120
9 (-7)
9 (-10)
WHITE BL
120
118 (40)
119 (40)
WHITE BL
236
11 (-6)
EAGLE TP
120
44 (-9)
Preliminary
2/13/96
LEGEND
0 - <100 kv
100 - <200 kv
200 - <231 kv
231 - <500 kv
500 kv and up
vit_115_op2_metric.lmp

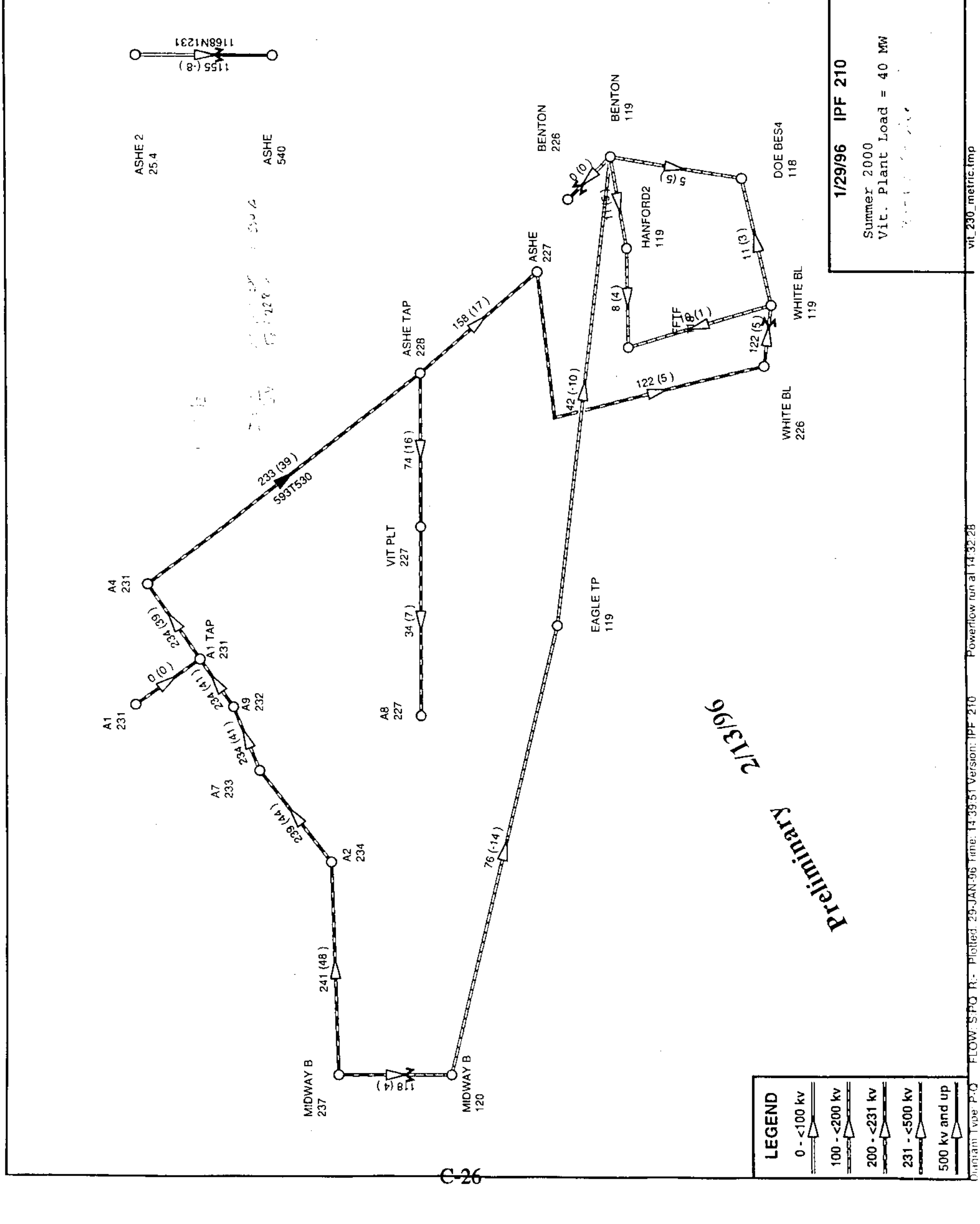

1/24/96 IPF 210
August 2000
Outage: Midway 230 - A2
and: Midway 230 - A8
Backfeed through White Bluffs
100 MVAR Caps at Ashe
vitplant_metric.tmp
BENTON 236 -22
BENTON 120 -26
DOE BES4 119 -28
HANFORD2 120 -27
ASHE 234 -32
ASHE TAP 234 -33
FFTF
WHITE BL 119 -29
WHITE BL 232 -31
VIT PLT 233 -33
A8 233 -33
A4 234 -33
A1 TAP 234 -33
A1 234 -33
A9 234 -33
A7 234 -33
A2 234 -33
EAGLE TP 120 -24
MIDWAY B 238 -17
MIDWAY B 120 -21
221 (-12)
100 (-14)
83 (-26)
82 (-19)
111 (-78)
111 (-84)
35 (-13)
224 (1)
76 (8)
72 (16)
32 (7)
4 (-6)
4 (-3)
0 (0)
4 (2)
4 (-1)
0 (-1)
70 (-15)
117 (0)
2/13/96
Preliminary
LEGEND
0 - <100 kv
100 - <200 kv
200 - <231 kv
231 - <500 kv
500 kv and up

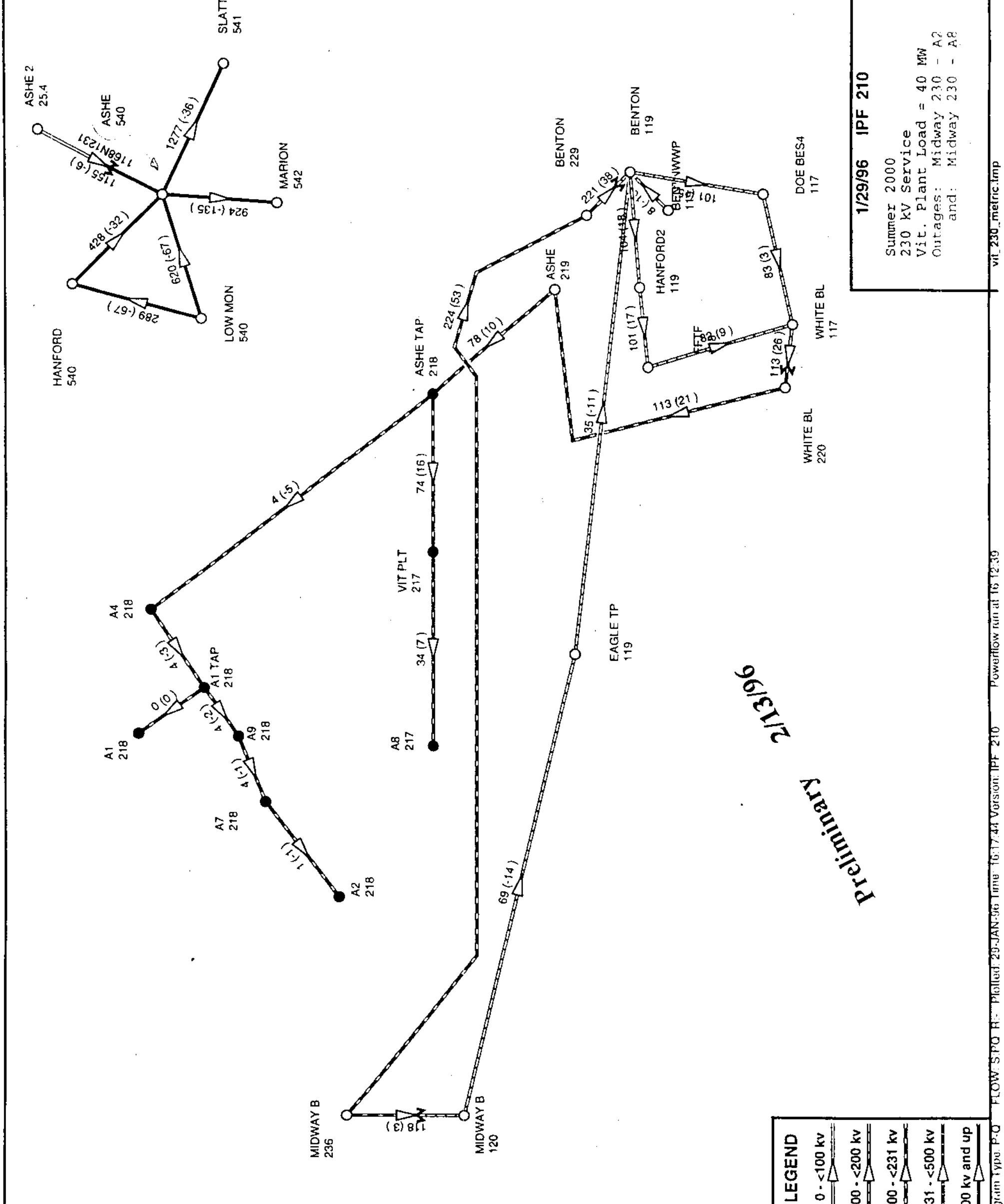

1/25/96 IPF 210
August 2000
230 kV Service
Line Outage: Midway - A2 and A8
Vitrification Plant Load = 60MW
100 MVAR Capacitor at Ashe
vit_115_op2_metric.lmp
BENTON 234
BENTON 120
DOE BES4 119
HANFORD2 120
ASHE 233
ASHE TAP 232
FFTF 119
WHITE BL 119
WHITE BL 231
VIT PLT 231
EAGLE TP 120
A4 232
A1 TAP 232
A1 232
A9 232
A7 232
A2 232
A8 231
MIDWAY B 238
MIDWAY B 120
228 (2)
107 (-11)
231 (16)
98 (14)
108 (-8)
90 (-23)
89 (-16)
134 (-69)
133 (-76)
37 (-15)
94 (21)
34 (7)
4 (-6)
4 (-3)
0 (0)
4 (-2)
4 (-1)
1 (-1)
72 (-16)
119 (-1)
2/13/96
Preliminary
LEGEND
0 - <100 kv
100 - <200 kv
200 - <231 kv
231 - <500 kv
500 kv and up
Diagram Type: P-Q FLOW S:PQ R: Plotted: 25-JAN-96 Time: 10:24:52 Version: IPF 210 Powerflow run at 10:20:45

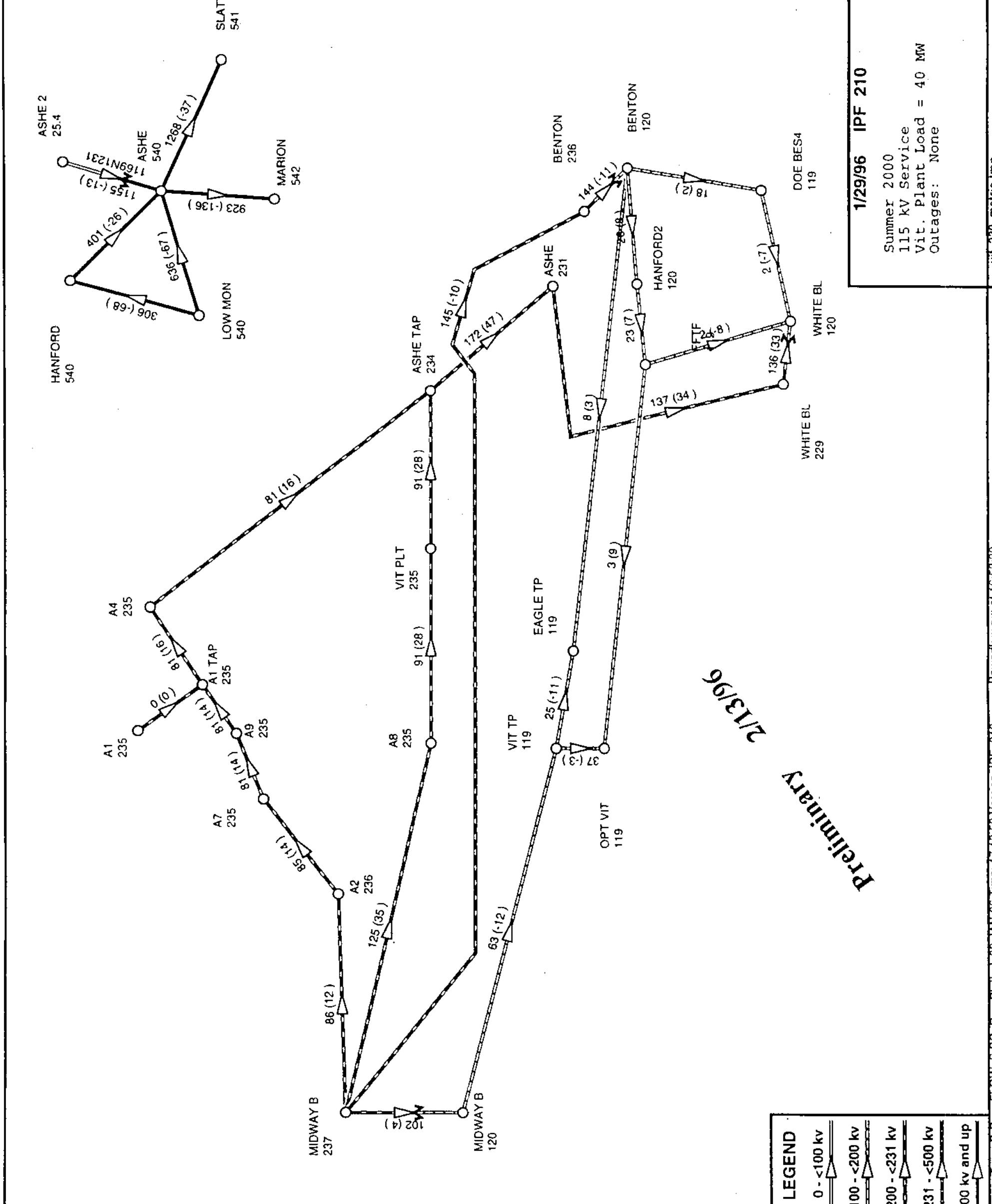

1/29/96 IPF 210
Summer 2000
230 kV Service
Vit. Plant Load = 40 MW
Shunt Caps at Ashe (100 MVAR)
vit 230 metric.lmp
LEGEND
0 - <100 kv
100 - <200 kv
200 - <231 kv
231 - <500 kv
500 kv and up
Preliminary
2/13/96
SLATT 541
ASHE 2 25.3
ASHE 540
MARION 541
HANFORD 540
LOW MON 540
BENTON 238
BENTON 120
DOE BES4 120
BENTNWWP 120
HANFORD2 120
ASHE 239
WHITE BL 120
WHITE BL 237
ASHE TAP 239
VIT PLT 239
A4 239
A1 TAP 239
A1 239
A9 238
A7 239
A8 238
A2 238
EAGLE TP 120
MIDWAY B 238
MIDWAY B 120
1267 (-37)
922 (-134)
337 (-69)
308 (-73)
137 (-21)
138 (-22)
162 (-49)
127 (47)
10 (-7)
25 (-2)
6 (-11)
22
86 (-23)
77 (-29)
117 (-19)
0 (-1)
86 (-25)
151 (-11)
90 (-27)
44 (-10)
90 (1)

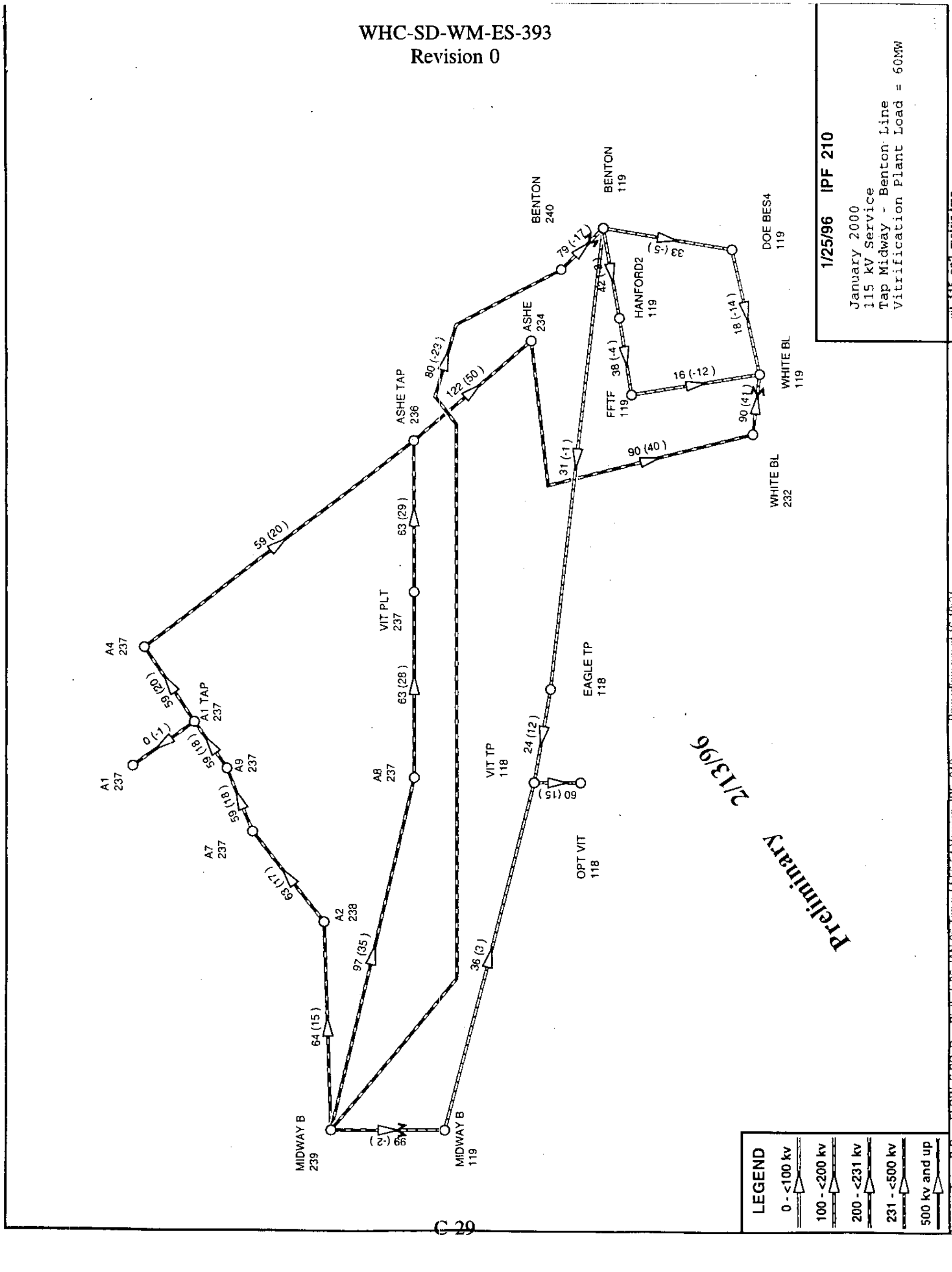

1/29/96 IPF 210
Summer 2000
Vit. Plant Load = 40 MW
Shunt Caps at Ashe (100 MVAR)
vit_230_metric.lmp
LEGEND
0 - <100 kv
100 - <200 kv
200 - <231 kv
231 - <500 kv
500 kv and up
ASHE 2
25.4
ASHE
540
1170N1231
1155 (-20)
BENTON
227
BENTON
120
DOE BES4
120
HANFORD2
120
ASHE
235
ASHE TAP
234
WHITE BL
120
WHITE BL
232
161 (-32)
237 (-12)
580T530
74 (16)
VIT PLT
234
34 (7)
A8
234
A4
236
A1 TAP
236
A1
236
A9
236
A7
237
A2
237
237 (-11)
0 (0)
237 (-10)
238 (-9)
242 (-6)
244 (-2)
MIDWAY B
238
MIDWAY B
120
137 (1)
76 (-15)
EAGLE TP
120
42 (-14)
126 (60)
125 (59)
12 (11)
4 (-2)
7 (-3)
FFTF
2/13/96
Preliminary

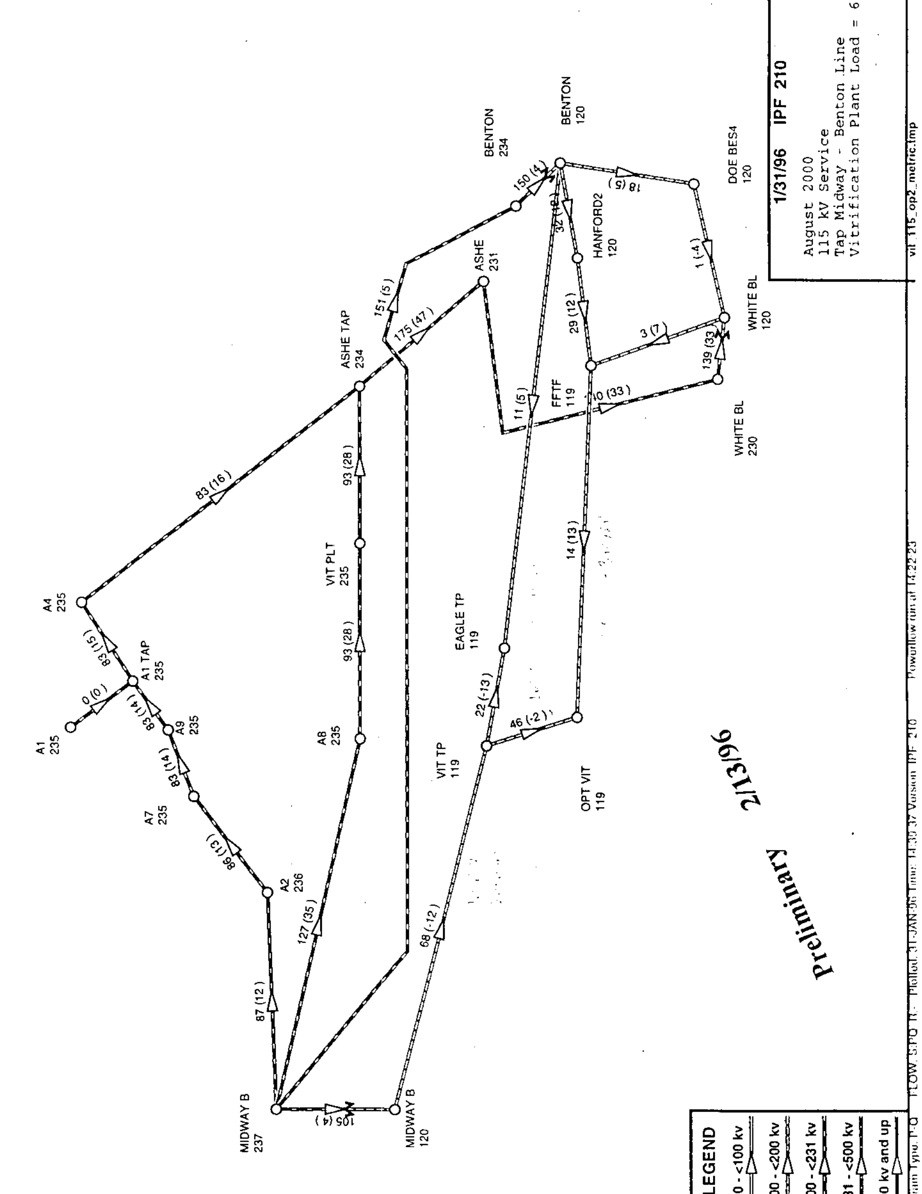

1/29/96 IPF 210
Summer 2000
230 kV Service
Vit. Plant Load = 40 MW
Outages: Midway 230 - A2
and: Midway 230 - A8
and: WNP-2
Shunt caps at Ashe (100 MVAR)
vit_230_metric.lmp
SLATT 541
ASHE 540
MARION 542
HANFORD 538
LOW MON 540
1139 (-55)
1161 (-175)
863 (-155)
844 (-78)
234 (-36)
BENTON 233
BENTON 120
DOE BES4 119
HANFORD2 120
WHITE BL 120
WHITE BL 239
ASHE 241
ASHE TAP 241
VIT PLT 240
A8 240
A4 241
A1 TAP 241
A1 241
A9 241
A7 241
A2 241
EAGLE TP 120
MIDWAY B 237
MIDWAY B 120
239 (-4)
105
87 (-27)
106 (-13)
113 (-91)
42 (-18)
242 (12)
78 (7)
4 (-6)
74 (15)
34 (7)
4 (-3)
0 (-1)
4 (-2)
76 (-19)
118 (-4)
2/13/96
Preliminary
LEGEND
0 - <100 kv
100 - <200 kv
200 - <231 kv
231 - <500 kv
500 kv and up
Diagram Type: P.Q FLOW: S,P,Q R: Plotted: 29-JAN-96 Time: 16:29:24 Version: IPF 210 Powerflow run at 16:23:58

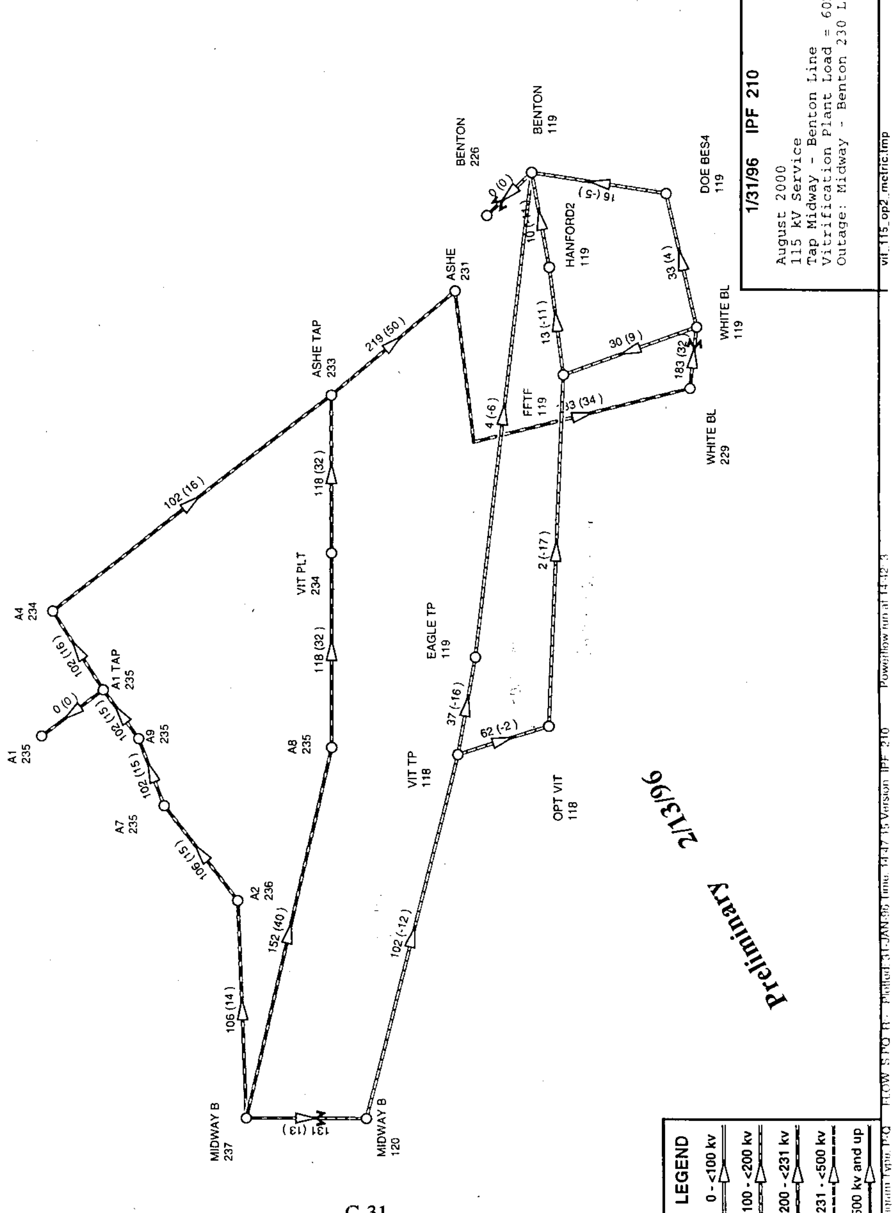

1/29/96 IPF 210
Summer 2000
Vit. Plant Load = 40 MW
vit_230_metric.fmp
ASHE 2
25.4
ASHE
540
1168N1231
1155 (-8)
BENTON
226
BENTON
119
DOE BES4
118
HANFORD2
119
ASHE
227
ASHE TAP
228
WHITE BL
119
WHITE BL
226
FFTF
VIT PLT
227
A8
227
A4
231
A1 TAP
231
A1
231
A9
232
A7
233
A2
234
EAGLE TP
119
MIDWAY B
237
MIDWAY B
120
233 (39)
593T530
158 (17)
74 (16)
34 (7)
234 (39)
234 (41)
239 (44)
241 (48)
76 (-14)
42 (-10)
122 (5)
11 (3)
5 (5)
8 (4)
0 (0)
Preliminary
2/13/96
LEGEND
0 - <100 kv
100 - <200 kv
200 - <231 kv
231 - <500 kv
500 kv and up
Powerflow run at 14:32:28

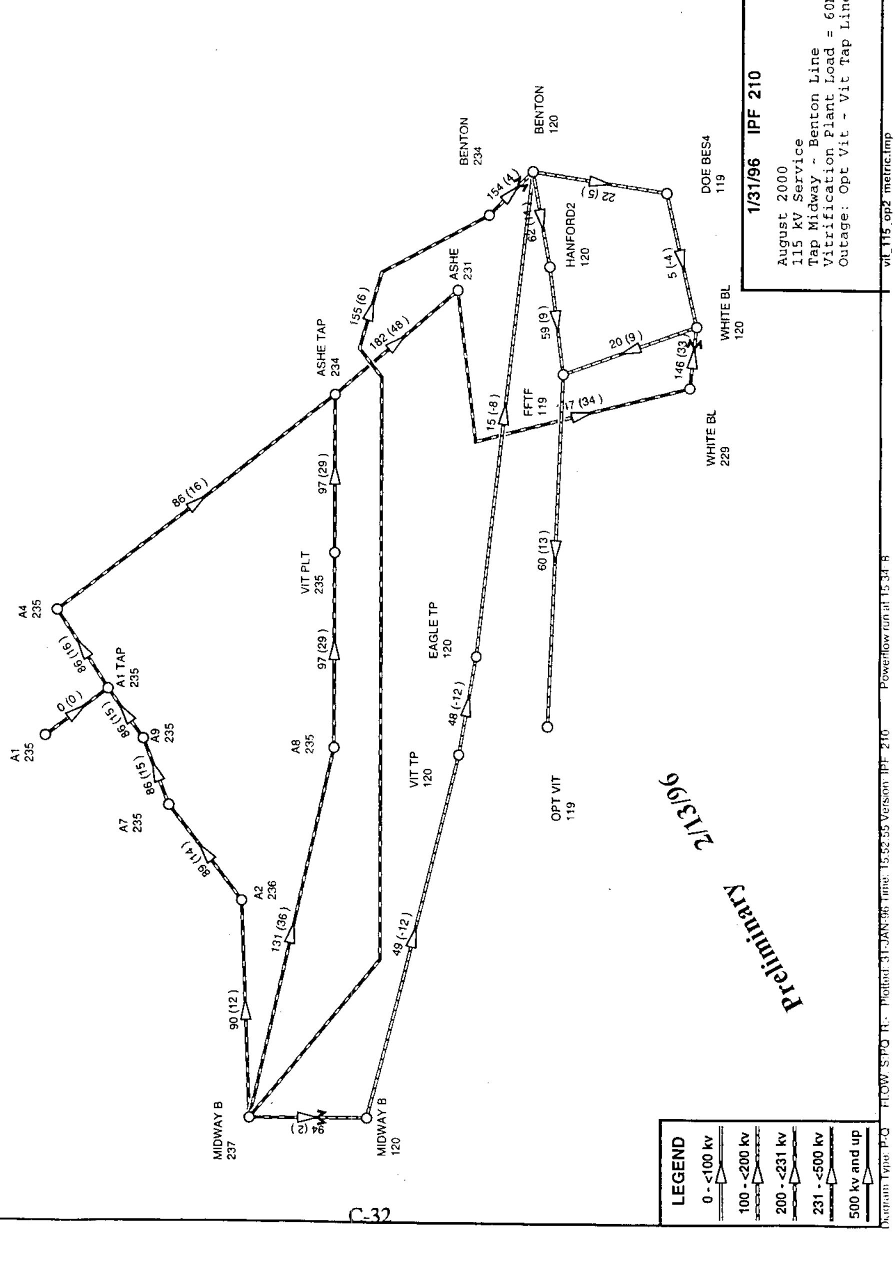

1/29/96 IPF 210
Summer 2000
230 kV Service
Vit. Plant Load = 40 MW
Outages: Midway 230 - A2
and: Midway 230 - A8
vit_230_metric.tmp
Preliminary
2/13/96
LEGEND
0 - <100 kv
100 - <200 kv
200 - <231 kv
231 - <500 kv
500 kv and up
SLATT
541
ASHE 2
25.4
ASHE
540
MARION
542
HANFORD
540
LOW MON
540
BENTON
229
BENTON
119
DOE BES4
117
HANFORD2
119
ASHE
219
WHITE BL
117
WHITE BL
220
ASHE TAP
218
VIT PLT
217
A8
217
A4
218
A1 TAP
218
A1
218
A9
218
A7
218
A2
218
EAGLE TP
119
MIDWAY B
236
MIDWAY B
120
Powerflow run at 16:12:39

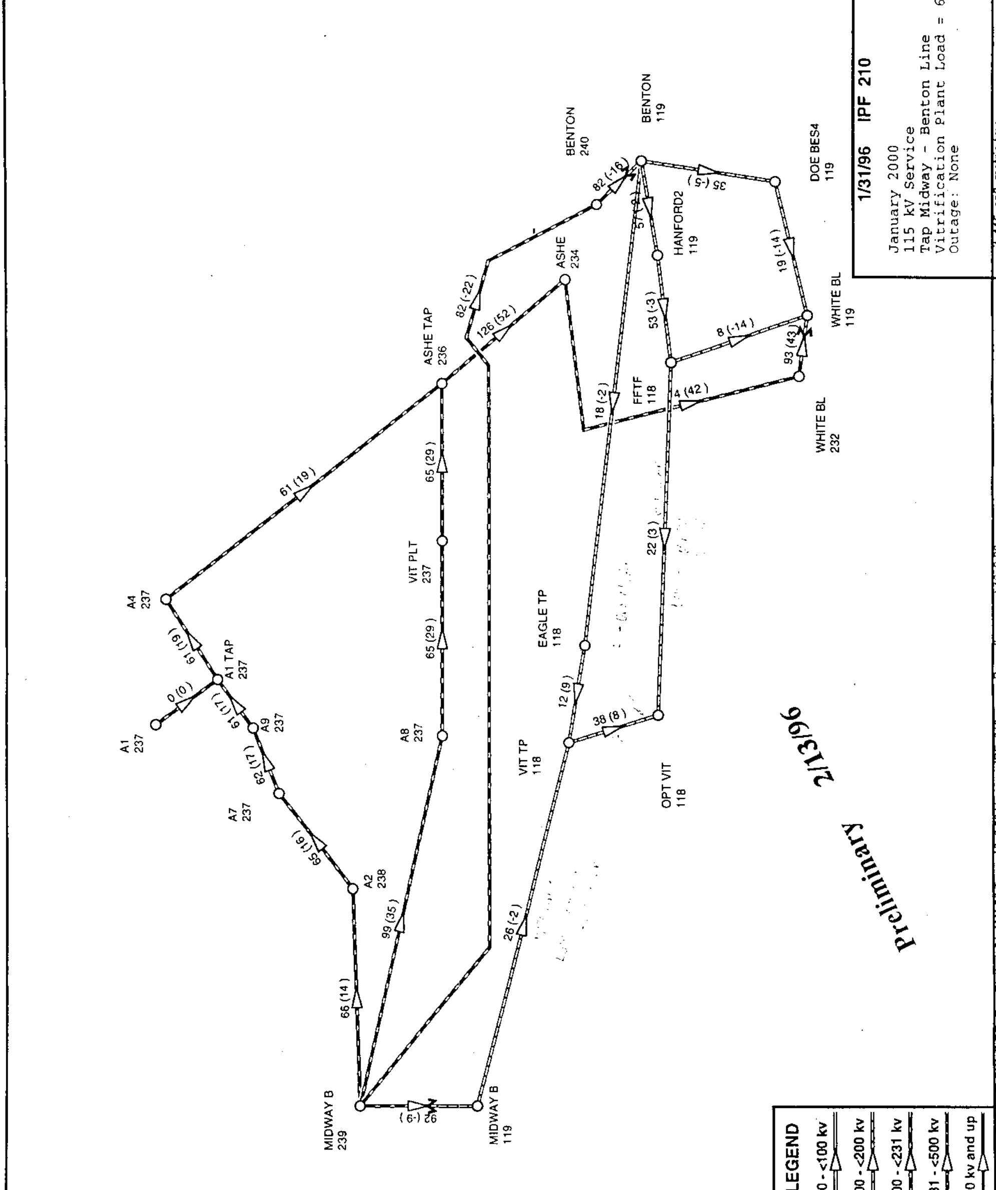

1/29/96 IPF 210
Summer 2000
115 kV Service
Vit. Plant Load = 40 MW
Outages: None
vit_230_metric.lmp
Preliminary
2/13/96
SLATT 541
ASHE 2 25.4
ASHE 540
MARION 542
HANFORD 540
LOW MON 540
1268 (-37)
1169N1231
1155 (-13)
923 (-136)
401 (-26)
636 (-67)
306 (-68)
BENTON 236
BENTON 120
DOE BES4 119
HANFORD2 120
ASHE 231
WHITE BL 120
WHITE BL 229
ASHE TAP 234
144 (-11)
18 (2)
28 (8)
2 (-7)
145 (-10)
172 (47)
23 (7)
FFTF
24 (-8)
136 (33)
137 (34)
8 (3)
81 (16)
91 (28)
VIT PLT 235
3 (9)
A4 235
EAGLE TP 119
A1 TAP 235
0 (0)
A1 235
81 (14)
A9 235
25 (-11)
VIT TP 119
37 (-3)
A8 235
A7 235
OPT VIT 119
85 (14)
A2 236
125 (35)
63 (-12)
86 (12)
MIDWAY B 237
102 (4)
MIDWAY B 120
LEGEND
0 - <100 kv
100 - <200 kv
200 - <231 kv
231 - <500 kv
500 kv and up
Diagram Type: P-Q
FLOW: S.PQ H.- Plotted: 29-JAN-96 Time: 17:13:59 Version: IPF 210
Powerflow run at 16:52:30

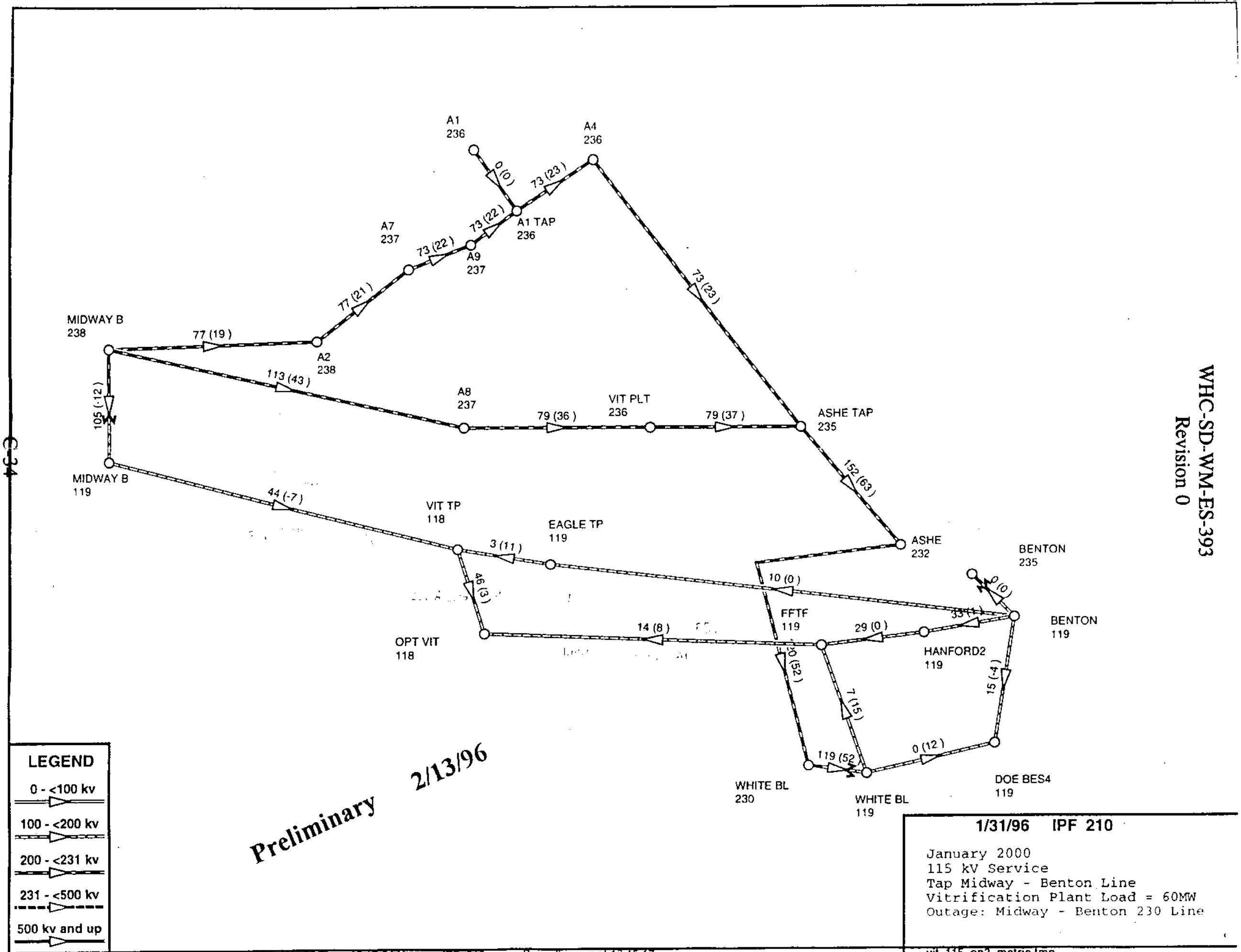

1/25/96 IPF 210
January 2000
115 kV Service
Tap Midway - Benton Line
Vitrification Plant Load = 60MW
Preliminary 2/13/96
LEGEND
0 - <100 kv
100 - <200 kv
200 - <231 kv
231 - <500 kv
500 kv and up
MIDWAY B 239
MIDWAY B 119
BENTON 240
BENTON 119
ASHE 234
ASHE TAP 236
VIT PLT 237
WHITE BL 232
WHITE BL 119
HANFORD2 119
FFTF 119
DOE BES4 119
EAGLE TP 118
VIT TP 118
OPT VIT 118
A1 237
A1 TAP 237
A2 238
A4 237
A7 237
A8 237
A9 237

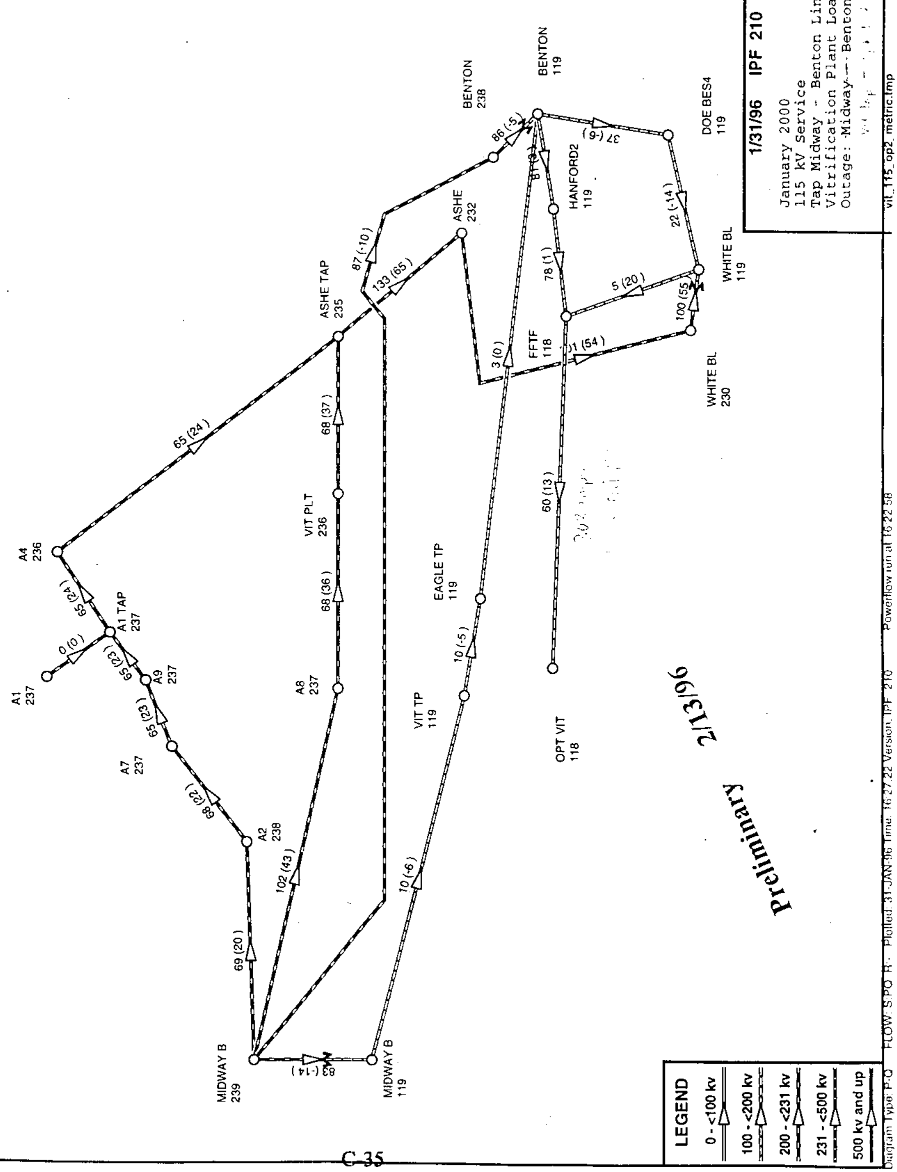

1/31/96 IPF 210
August 2000
115 kV Service
Tap Midway - Benton Line
Vitrification Plant Load = 60MW
vit_115_op2_metric.fmp
MIDWAY B 237
MIDWAY B 120
105 (4)
87 (12)
127 (35)
68 (-12)
A2 236
86 (13)
A7 235
83 (14)
A9 235
83 (14)
A1 235
0 (0)
A1 TAP 235
83 (15)
A4 235
83 (16)
A8 235
93 (28)
VIT PLT 235
93 (28)
ASHE TAP 234
175 (47)
151 (5)
ASHE 231
BENTON 234
150 (4)
BENTON 120
18 (5)
DOE BES4 120
32 (12)
HANFORD2 120
29 (12)
1 (-4)
WHITE BL 120
3 (7)
139 (33)
WHITE BL 230
10 (33)
FFTF 119
11 (5)
14 (13)
EAGLE TP 119
22 (-13)
VIT TP 119
46 (-2)
OPT VIT 119
2/13/96
Preliminary
LEGEND
0 - <100 kv
100 - <200 kv
200 - <231 kv
231 - <500 kv
500 kv and up

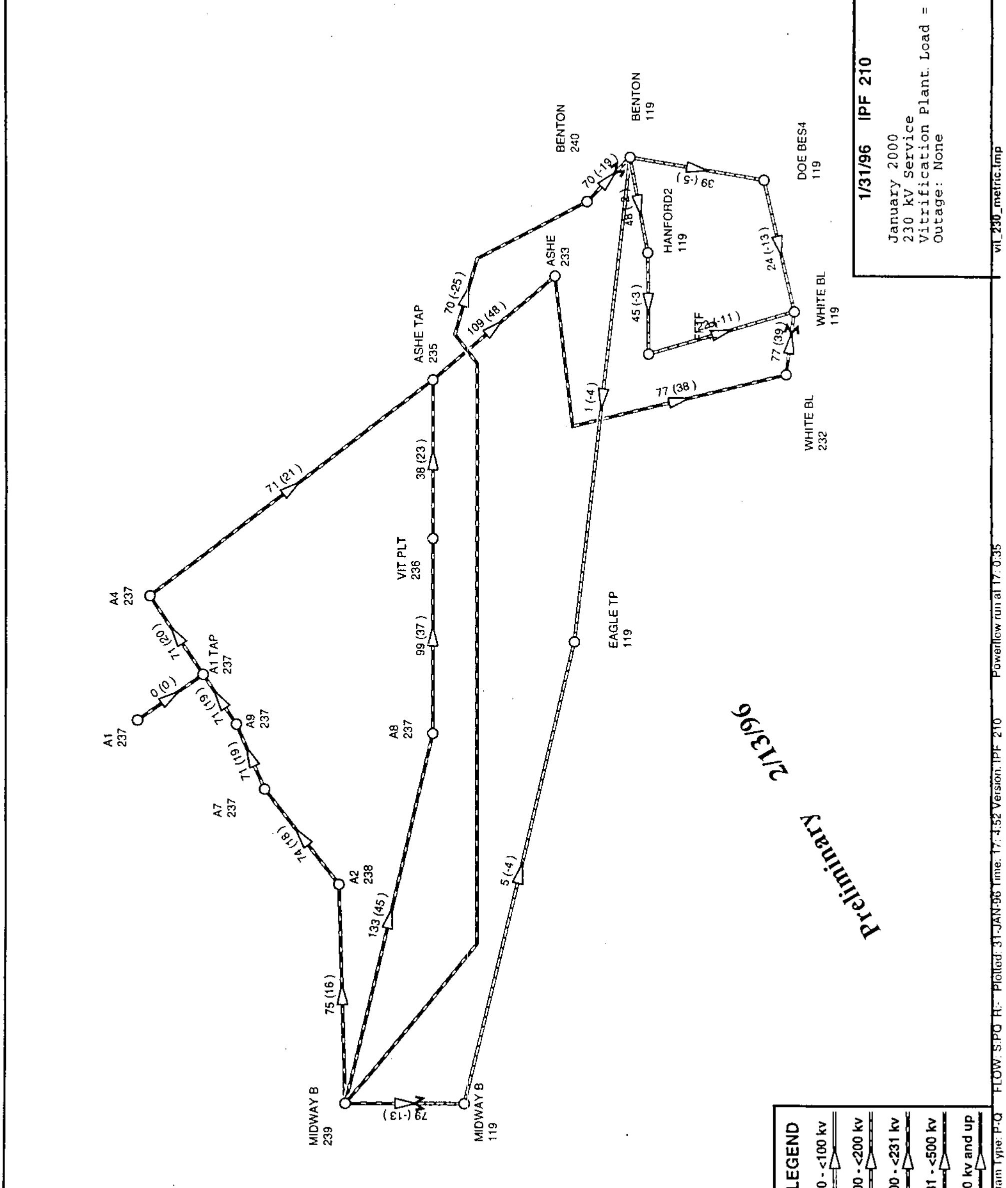

1/31/96 IPF 210
August 2000
115 kV Service
Tap Midway - Benton Line
Vitrification Plant Load = 60MW
Outage: Midway - Benton 230 Line
MIDWAY B 237
MIDWAY B 120
131 (13)
106 (14)
152 (40)
102 (-12)
A2 236
106 (15)
A7 235
102 (15)
A9 235
102 (15)
A1 235
0 (0)
A1 TAP 235
102 (16)
A4 234
102 (16)
A8 235
118 (32)
VIT PLT 234
118 (32)
ASHE TAP 233
219 (50)
ASHE 231
VIT TP 118
37 (-16)
62 (-2)
OPT VIT 118
EAGLE TP 119
2 (-17)
4 (-6)
FFTF 119
33 (34)
WHITE BL 229
183 (32)
WHITE BL 119
30 (9)
13 (-11)
HANFORD2 119
33 (4)
DOE BES4 119
16 (-5)
BENTON 119
BENTON 226
0 (0)
Preliminary
2/13/96
LEGEND
0 - <100 kv
100 - <200 kv
200 - <231 kv
231 - <500 kv
500 kv and up
vit_115_op2_mcfric.lmp

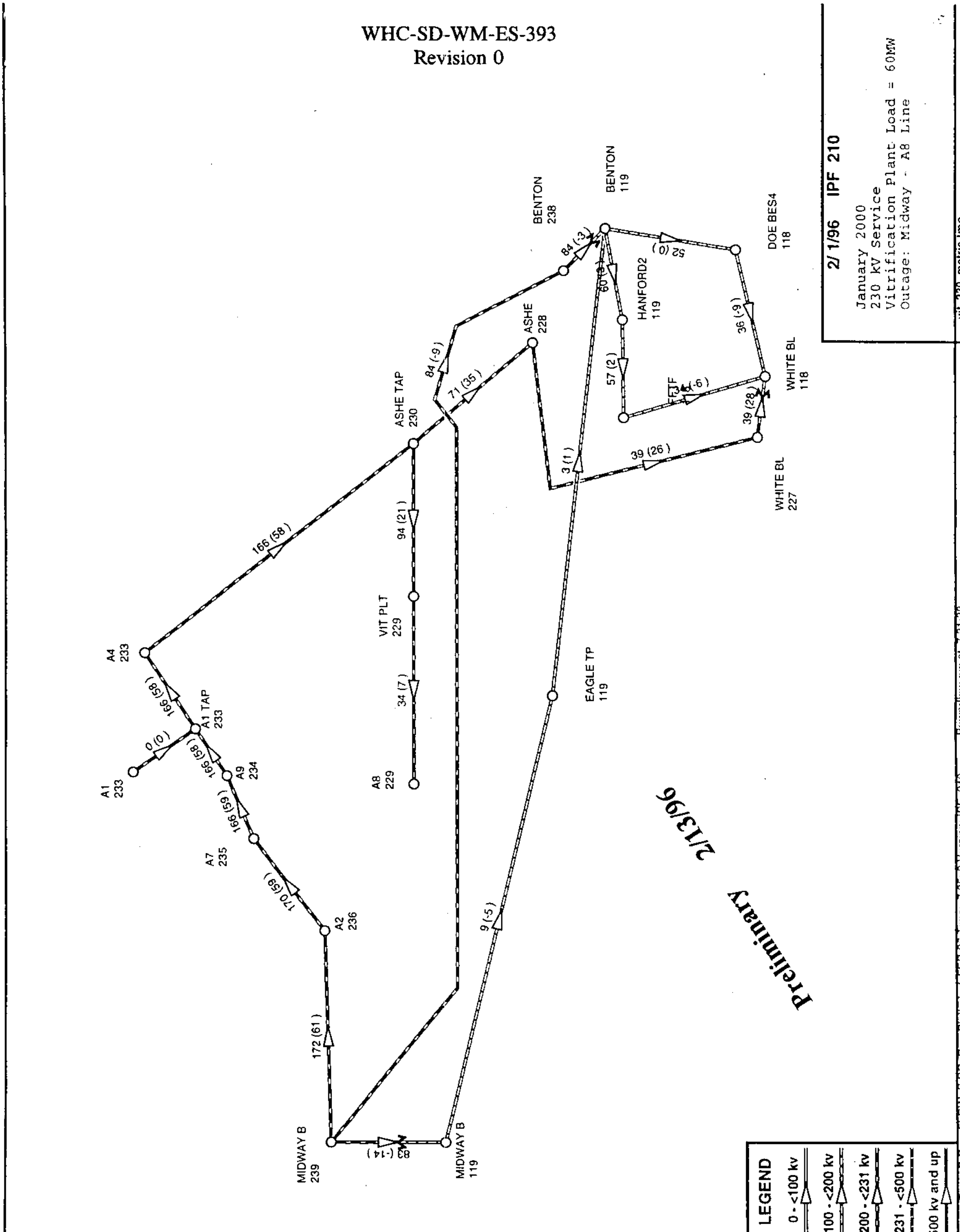

1/31/96 IPF 210
August 2000
115 kV Service
Tap Midway - Benton Line
Vitrification Plant Load = 60MW
Outage: Opt Vit - Vit Tap Line
vit_115_op2 metric.lmp
BENTON 234
BENTON 120
DOE BES4 119
HANFORD2 120
ASHE 231
ASHE TAP 234
WHITE BL 120
WHITE BL 229
FFTF 119
VIT PLT 235
EAGLE TP 120
VIT TP 120
OPT VIT 119
A4 235
A1 TAP 235
A1 235
A9 235
A7 235
A2 236
A8 235
MIDWAY B 237
MIDWAY B 120
154 (4)
22 (5)
62 (11)
5 (-4)
155 (6)
182 (48)
59 (9)
20 (9)
146 (33)
15 (-8)
17 (34)
86 (16)
97 (29)
60 (13)
86 (16)
97 (29)
0 (0)
86 (15)
48 (-12)
86 (15)
89 (14)
131 (36)
49 (-12)
90 (12)
94 (2)
2/13/96
Preliminary
LEGEND
0 - <100 kv
100 - <200 kv
200 - <231 kv
231 - <500 kv
500 kv and up
Diagram Type: P-Q   FLOW: SPQ R: Plotted: 31-JAN-96 time: 15:52:55 Version: IPF 210   Powerflow run at 15:34:8

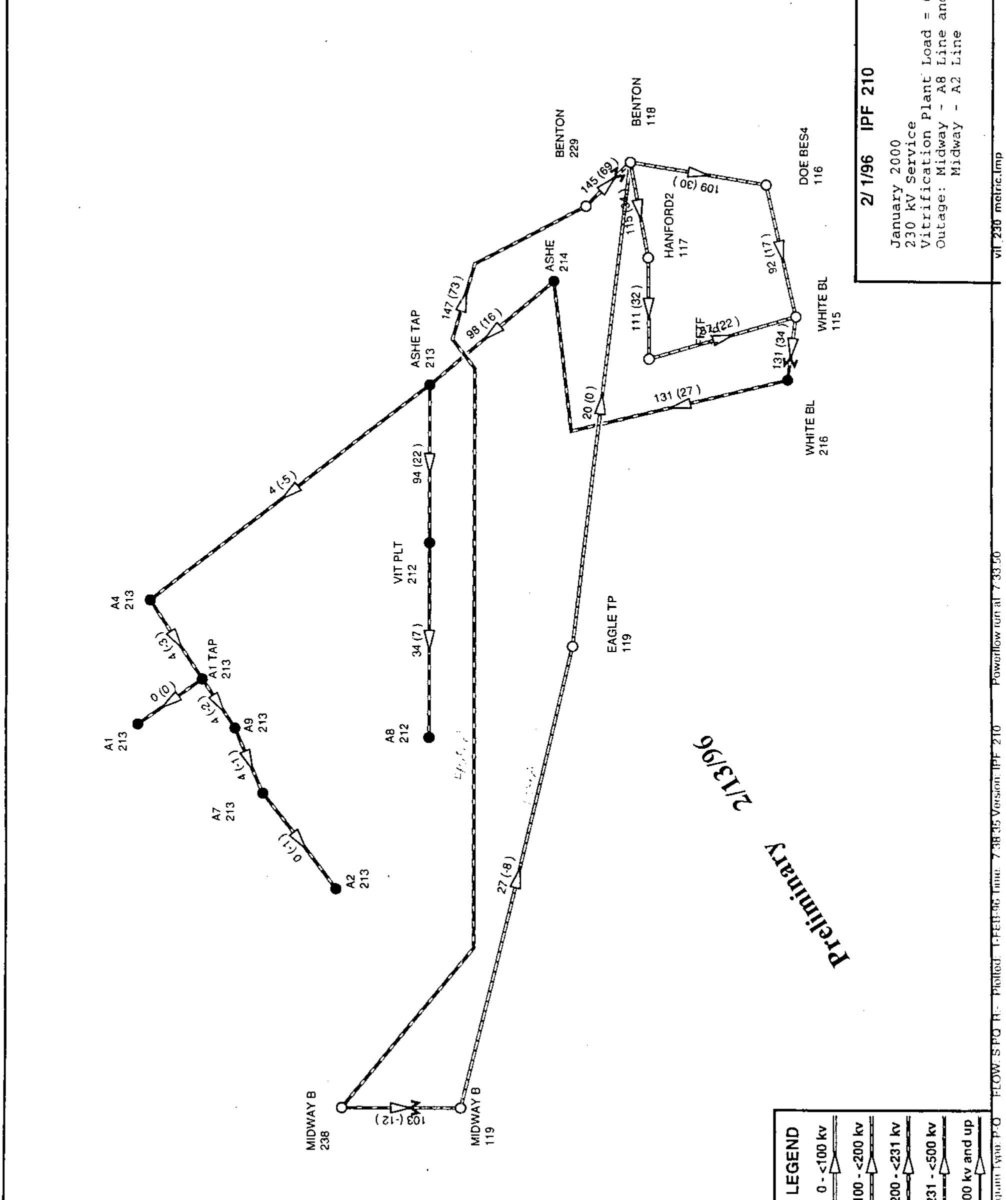

1/31/96 IPF 210
January 2000
115 kV Service
Tap Midway - Benton Line
Vitrification Plant Load = 60MW
Outage: None
vit_115_op2_metric.tmp
Diagram Type: P-Q FLOW: SPQ R: Plotted: 31-JAN-96 Time: 16: 6:58 Version: IPF 210 Powerflow run at 16: 2:36
LEGEND
0 - <100 kv
100 - <200 kv
200 - <231 kv
231 - <500 kv
500 kv and up
2/13/96
Preliminary
BENTON 240
BENTON 119
DOE BES4 119
HANFORD2 119
ASHE 234
ASHE TAP 236
WHITE BL 119
WHITE BL 232
FFTF 118
VIT PLT 237
EAGLE TP 118
VIT TP 118
OPT VIT 118
A4 237
A1 TAP 237
A1 237
A9 237
A7 237
A8 237
A2 238
MIDWAY B 239
MIDWAY B 119
82 (-16)
35 (-5)
57
19 (-14)
53 (-3)
8 (-14)
93 (43)
4 (42)
18 (-2)
62 (-22)
126 (52)
61 (19)
65 (29)
65 (29)
22 (3)
12 (9)
38 (8)
61 (19)
0 (0)
61 (17)
62 (17)
55 (16)
99 (35)
26 (-2)
66 (14)
92 (-9)

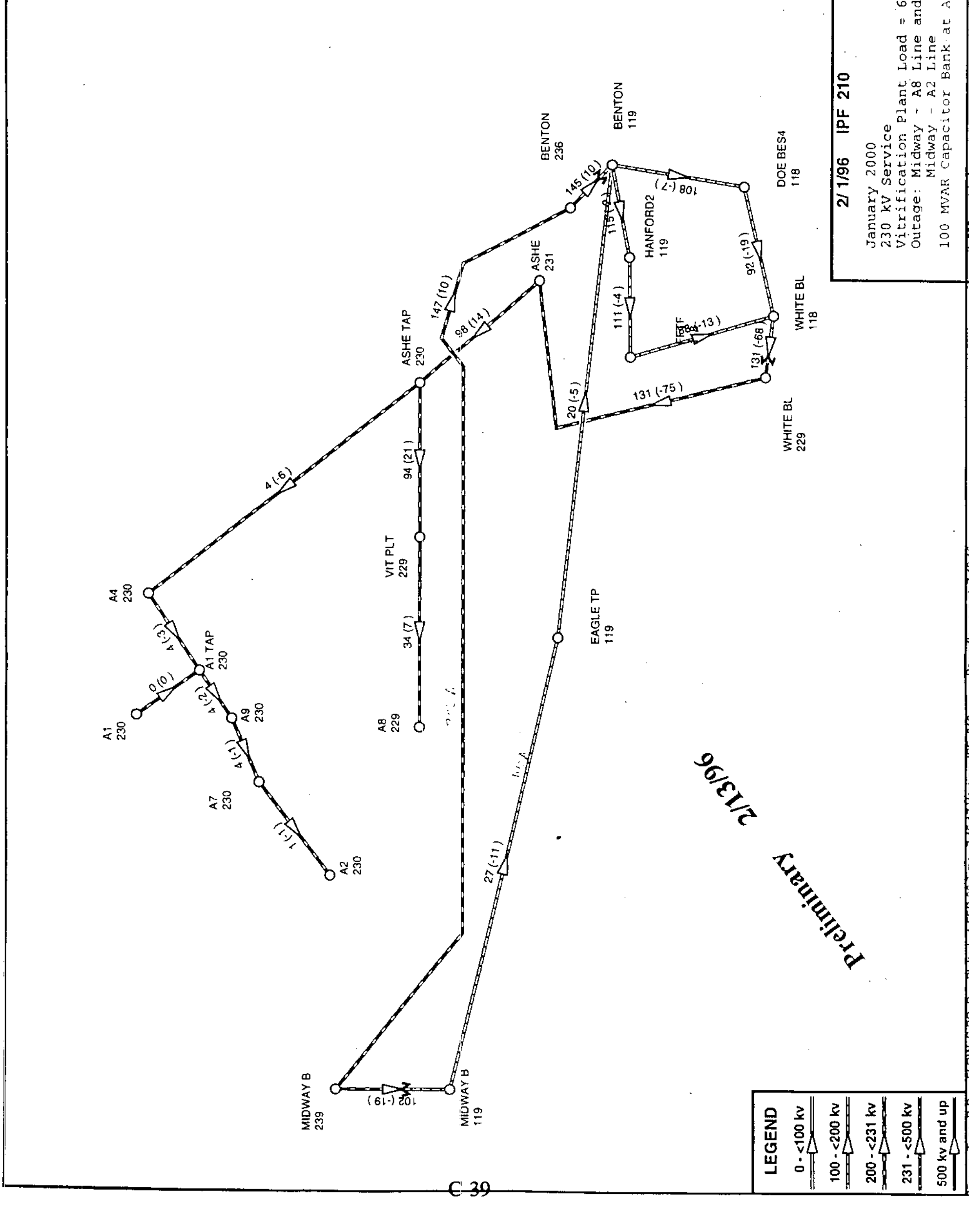

A1
236
0 (0)
A4
236
73 (23)
A1 TAP
236
73 (22)
A9
237
A7
237
73 (22)
77 (21)
MIDWAY B
238
77 (19)
A2
238
113 (43)
A8
237
79 (36)
VIT PLT
236
79 (37)
ASHE TAP
235
73 (23)
152 (63)
105 (-12)
MIDWAY B
119
44 (-7)
VIT TP
118
EAGLE TP
119
3 (11)
ASHE
232
BENTON
235
0 (0)
10 (0)
46 (3)
BENTON
119
33 (1)
FFTF
119
14 (8)
29 (0)
OPT VIT
118
HANFORD2
119
20 (52)
7 (15)
15 (-4)
0 (12)
119 (52)
WHITE BL
230
WHITE BL
119
DOE BES4
119
LEGEND
0 - <100 kv
100 - <200 kv
200 - <231 kv
231 - <500 kv
500 kv and up
Preliminary 2/13/96
1/31/96 IPF 210
January 2000
115 kV Service
Tap Midway - Benton Line
Vitrification Plant Load = 60MW
Outage: Midway - Benton 230 Line
vit_115_op2_metric.lmp
Diagram Type: P-Q FLOW: S.PQ R:- Plotted: 31-JAN-96 Time: 16:17:54 Version: IPF 210 Powerflow run at 16:15:17

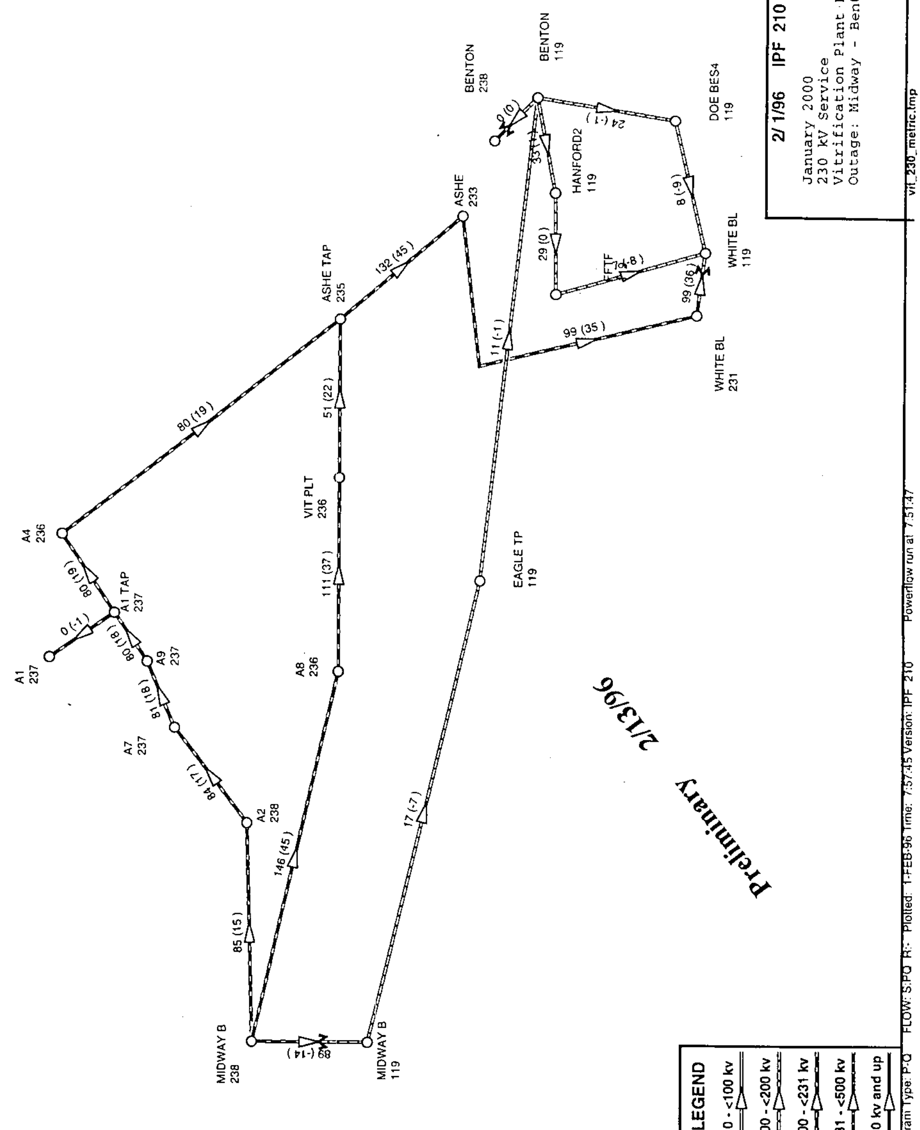

1/31/96 IPF 210
January 2000
115 kV Service
Tap Midway - Benton Line
Vitrification Plant Load = 60MW
Outage: Midway - Benton 230 Line
vit_115_op2_metric.fmp
LEGEND
0 - <100 kv
100 - <200 kv
200 - <231 kv
231 - <500 kv
500 kv and up
Diagram Type: P-Q FLOW: S.PO R. Plotted: 31-JAN-96 Time: 16:27:22 Version: IPF 210 Powerflow run at 16:22:58
Preliminary
2/13/96
MIDWAY B 239
MIDWAY B 119
A2 238
A7 237
A9 237
A1 237
A1 TAP 237
A4 236
A8 237
VIT PLT 236
ASHE TAP 235
ASHE 232
BENTON 238
BENTON 119
DOE BES4 119
HANFORD2 119
WHITE BL 119
WHITE BL 230
FFTF 118
EAGLE TP 119
VIT TP 119
OPT VIT 118
69 (20)
68 (22)
65 (23)
65 (23)
65 (24)
0 (0)
65 (24)
102 (43)
68 (36)
68 (37)
133 (65)
87 (-10)
86 (-5)
37 (-6)
22 (-14)
5 (20)
100 (55)
78 (1)
60 (13)
3 (0)
10 (-5)
10 (-6)
83 (-14)

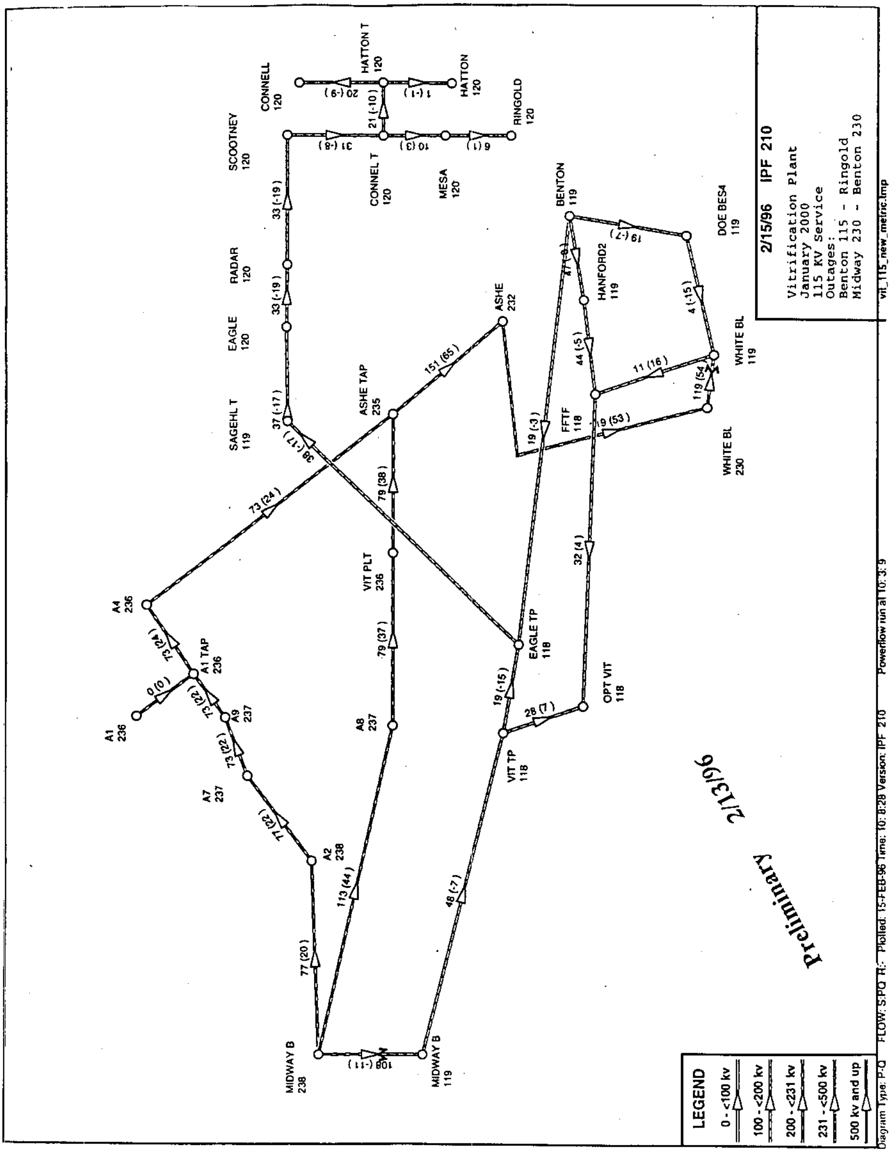

1/31/96 IPF 210
January 2000
230 kV Service
Vitrification Plant Load = 60MW
Outage: None
vit_230_metric.lmp
BENTON 240
BENTON 119
DOE BES4 119
HANFORD2 119
ASHE 233
ASHE TAP 235
WHITE BL 119
WHITE BL 232
VIT PLT 236
EAGLE TP 119
A4 237
A1 TAP 237
A1 237
A9 237
A7 237
A8 237
A2 238
MIDWAY B 239
MIDWAY B 119
70 (-19)
39 (-5)
48 (-2)
24 (-13)
45 (-3)
70 (-25)
109 (48)
77 (39)
77 (38)
1 (-4)
71 (21)
38 (23)
99 (37)
71 (20)
0 (0)
71 (19)
71 (19)
74 (18)
133 (45)
5 (-4)
75 (16)
79 (-13)
LEGEND
0 - <100 kv
100 - <200 kv
200 - <231 kv
231 - <500 kv
500 kv and up
2/13/96
Preliminary

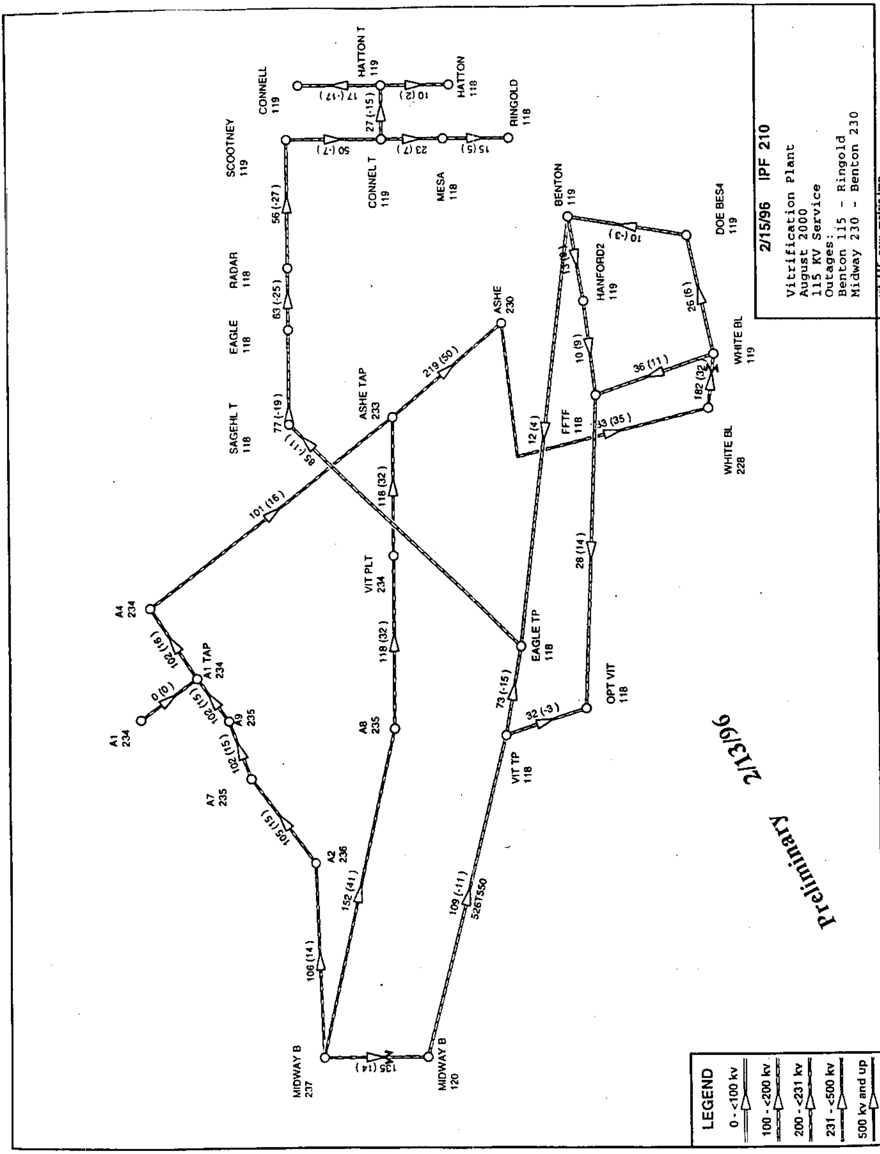

2/1/96 IPF 210
January 2000
230 kV Service
Vitrification Plant Load = 60MW
Outage: Midway - A8 Line
vit_230_metric.tmp
BENTON 238
BENTON 119
DOE BES4 118
HANFORD2 119
ASHE 228
WHITE BL 118
WHITE BL 227
ASHE TAP 230
VIT PLT 229
EAGLE TP 119
A4 233
A1 TAP 233
A1 233
A9 234
A8 229
A7 235
A2 236
MIDWAY B 239
MIDWAY B 119
84 (-3)
52 (0)
60 (-3)
36 (-9)
84 (-9)
71 (35)
57 (2)
34 (-6)
39 (28)
39 (26)
3 (1)
166 (58)
94 (21)
34 (7)
166 (58)
0 (0)
166 (58)
166 (59)
170 (59)
9 (-5)
172 (61)
83 (-14)
Preliminary 2/13/96
LEGEND
0 - <100 kv
100 - <200 kv
200 - <231 kv
231 - <500 kv
500 kv and up
Diagram Type: P-Q FLOW S PQ H - Plotted: 1-FEB-96 Time: 7:25:9 Version: IPF 210 Powerflow run at 7:21:38


2/1/96 IPF 210
January 2000
230 kV Service
Vitrification Plant Load = 60MW
Outage: Midway - A8 Line and
Midway - A2 Line
BENTON
229
BENTON
118
DOE BES4
116
HANFORD2
117
WHITE BL
115
WHITE BL
216
ASHE
214
ASHE TAP
213
VIT PLT
212
A8
212
A4
213
A1 TAP
213
A1
213
A9
213
A7
213
A2
213
EAGLE TP
119
MIDWAY B
238
MIDWAY B
119
145 (69)
109 (30)
115 (34)
92 (17)
111 (32)
131 (34)
131 (27)
147 (73)
98 (16)
20 (0)
94 (22)
34 (7)
4 (-5)
4 (-3)
0 (0)
4 (-2)
4 (-1)
0 (-1)
27 (-8)
103 (-12)
Preliminary
2/13/96
LEGEND
0 - <100 kv
100 - <200 kv
200 - <231 kv
231 - <500 kv
500 kv and up
vit_230_metric.lmp


2/ 1/96 IPF 210
January 2000
230 kV Service
Vitrification Plant Load = 60MW
Outage: Midway - A8 Line and
Midway - A2 Line
100 MVAR Capacitor Bank at Ashe
vit_230_metric.lmp
BENTON 236
BENTON 119
DOE BES4 118
HANFORD2 119
WHITE BL 118
WHITE BL 229
ASHE 231
ASHE TAP 230
VIT PLT 229
A8 229
A4 230
A1 TAP 230
A1 230
A9 230
A7 230
A2 230
EAGLE TP 119
MIDWAY B 239
MIDWAY B 119
145 (10)
108 (-7)
115
92 (-19)
111 (-4)
131 (-68
131 (-75)
20 (-5)
147 (10)
98 (14)
94 (21)
34 (7)
4 (-6)
4 (-3)
0 (0)
4 (-2)
4 (-1)
1 (-1)
27 (-11)
102 (-19)
Preliminary
2/13/96
LEGEND
0 - <100 kv
100 - <200 kv
200 - <231 kv
231 - <500 kv
500 kv and up
Diagram Type: P-Q FLOW: S:PQ R:- Plotted: 1-FEB-96 Time: 7:46:17 Version: IPF 210 Powerflow run at 7:42:16


2/1/96 IPF 210
January 2000
230 kV Service
Vitrification Plant Load = 60MW
Outage: Midway - Benton Line
Preliminary 2/13/96
LEGEND
0 - <100 kv
100 - <200 kv
200 - <231 kv
231 - <500 kv
500 kv and up
Diagram Type: P-Q FLOW: S:PQ R:- Plotted: 1-FEB-96 Time: 7:57:45 Version: IPF 210 Powerflow run at 7:51:47
vit_230_metric.lmp
BENTON 238
BENTON 119
DOE BES4 119
HANFORD2 119
WHITE BL 119
WHITE BL 231
ASHE 233
ASHE TAP 235
VIT PLT 236
EAGLE TP 119
A4 236
A1 TAP 237
A1 237
A9 237
A7 237
A8 236
A2 238
MIDWAY B 238
MIDWAY B 119
0 (0)
24 (-1)
33 (-1)
8 (-9)
29 (0)
99 (36)
99 (35)
11 (-1)
132 (45)
80 (19)
51 (22)
111 (37)
80 (19)
0 (-1)
80 (18)
81 (18)
84 (17)
146 (45)
85 (15)
17 (-7)
89 (-14)


2/15/96 IPF 210
Vitrification Plant
January 2000
115 KV Service
Outages:
Benton 115 - Ringold
Midway 230 - Benton 230
vit_115_new_metric.tmp
CONNELL 120
HATTON T 120
HATTON 120
RINGOLD 120
SCOOTNEY 120
CONNEL T 120
MESA 120
RADAR 120
EAGLE 120
SAGEHL T 119
ASHE TAP 235
ASHE 232
BENTON 119
HANFORD2 119
DOE BES4 119
WHITE BL 119
WHITE BL 230
FFTF 118
VIT PLT 236
EAGLE TP 118
OPT VIT 118
VIT TP 118
A4 236
A1 TAP 236
A1 236
A9 237
A8 237
A7 237
A2 238
MIDWAY B 238
MIDWAY B 119
Preliminary
2/13/96
LEGEND
0 - <100 kv
100 - <200 kv
200 - <231 kv
231 - <500 kv
500 kv and up
Diagram Type: P-Q FLOW: S:PQ R:- Plotted: 15-FEB-96 Time: 10: 8:28 Version: IPF 210 Powerflow run at 10: 3: 9


2/15/96 IPF 210
Vitrification Plant
August 2000
115 KV Service
Outages:
Benton 115 - Ringold
Midway 230 - Benton 230
vit_115_new_metric.lmp
LEGEND
0 - <100 kv
100 - <200 kv
200 - <231 kv
231 - <500 kv
500 kv and up
Preliminary
2/13/96
CONNELL 119
HATTON T 119
HATTON 118
RINGOLD 118
SCOOTNEY 119
CONNEL T 119
MESA 118
BENTON 119
DOE BES4 119
RADAR 118
EAGLE 118
ASHE 230
HANFORD2 119
WHITE BL 119
SAGEHL T 118
ASHE TAP 233
FFTF 118
WHITE BL 228
A4 234
VIT PLT 234
EAGLE TP 118
A1 TAP 234
OPT VIT 118
A1 234
A9 235
A8 235
VIT TP 118
A7 235
A2 236
MIDWAY B 237
MIDWAY B 120
526T550
Diagram Type: P,Q FLOW: S,PQ R: Plotted: 15-FEB-96 Time: 11: 4: 6 Version: IPF 210 Powerflow run at 10:56:21

APPENDIX D

ELECTRICAL POWER FOR PHASE I PRIVATIZATION 230 kV SUBSTATION COST ESTIMATE

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KAISER ENGINEERS HANFORD
Westinghouse Hanford Company
JOB NO. P6P200 Z-405
FILE NO. Z405SAA3

** IEST - INTERACTIVE ESTIMATING **
Electrical Power for Phase 1 - Privatization
Study Estimate (Based on B-595 HWVP estimate)
DOE_R01 - PROJECT COST SUMMARY

PAGE 1 OF 8
DATE 05/30/96 07:49:57
BY JJK

COST CODE	DESCRIPTION	TOTAL COST	CONTINGENCY %	CONTINGENCY TOTAL	TOTAL DOLLARS
000	Engineering	1,530,000	15	230,000	1,760,000
060	Project Management	460,000	15	70,000	530,000
	(ADJUSTED TO MEET DOE 5100.4)	10,000		0	10,000
Engineering Total		2,000,000		300,000	2,300,000
170	Electrical Site Utilities	210,000	18	40,000	250,000
190	Final Site Work	10,000	19	0	10,000
380	HPS/DCS/MIS/ALCS Installation	40,000	18	10,000	50,000
410	Switchgear Bldg	950,000	17	160,000	1,110,000
420	HV Line & Substation	5,640,000	17	960,000	6,600,000
P13	13.8KV Switchgear	630,000	17	110,000	740,000
P14	DCS/MIS	180,000	18	30,000	210,000
	(ADJUSTED TO MEET DOE 5100.4)	40,000		-10,000	30,000
Construction Total		7,700,000	17	1,300,000	9,000,000
	TEC PROJECT TOTAL	9,700,000	17	1,600,000	11,300,000

TYPE OF ESTIMATE	Study Estimate 05/30/96	REMARKS: Escalation costs are not included due to lack of time frame and schedule for this activity. Operating Contractor OPC (Other Project Costs) are not included in this study per ICF KH engineer instructions.
ARCHITECT ENGINEER		
OPERATING CONTRACTOR		

(ROUNDED/ADJUSTED TO THE NEAREST " 10,000 / 100,000 " - PERCENTAGES NOT RECALCULATED TO REFLECT ROUNDING)

KAISER ENGINEERS HANFORD
Westinghouse Hanford Company
JOB NO. P6P200 Z-405
FILE NO. Z405SAA3

** IEST - INTERACTIVE ESTIMATING **
Electrical Power for Phase 1 - Privatization
Study Estimate (Based on B-595 HWVP estimate)
DOE_R02 - WORK BREAKDOWN STRUCTURE SUMMARY

PAGE 2 OF 8
DATE 05/30/96 07:50:05
BY JJM

WBS	DESCRIPTION	ESTIMATE SUBTOTAL	ONSITE INDIRECTS	SUB TOTAL	ESCALATION %	ESCALATION TOTAL	SUB TOTAL	CONTINGENCY %	CONTINGENCY TOTAL	TOTAL DOLLARS
110000	Definitive Design - Allowance	766772	0	766772	0.00	0	766772	15	115016	881788
120000	Field Engr/Inspection - Allowance	766772	0	766772	0.00	0	766772	15	115016	881788
SUBTOTAL 1	Engineering	1533544	0	1533544	0.00	0	1533544	15	230032	1763576
22J320	NORMAL ELECTRICAL DISTRIBUTION	634938	0	634938	0.00	0	634938	17	107939	742877
22J610	DISTRIBUTED CONTROL SYSTEM	182666	0	182666	0.00	0	182666	18	32880	215546
22JIN1	TA NO 40 ESTIMATE ALLOWANCE	315835	0	315835	0.00	0	315835	19	60009	375844
SUBTOTAL 22J	Switchgear Building	1133439	0	1133439	0.00	0	1133439	18	200828	1334267
SUBTOTAL 2	Procurement	1133439	0	1133439	0.00	0	1133439	18	200828	1334267
32J100	SWITCHGEAR BUILDING	330000	64680	394680	0.00	0	394680	15	59202	453882
32J320	NORMAL ELECTRICAL DISTRIBUTION	135843	26625	162468	0.00	0	162468	17	27620	190088
32J350	DC	38436	7533	45969	0.00	0	45969	19	8734	54704
32J610	DISTRIBUTED CONTROL SYSTEM	17710	3471	21181	0.00	0	21181	18	3812	24994
32J650	COMMUNICATIONS	10628	2083	12711	0.00	0	12711	18	2288	14999
32JIN1	TA NO 40 ESTIMATE ALLOWANCE	12636	2477	15113	0.00	0	15113	19	2871	17984
SUBTOTAL 32J	Switchgear Building	545253	106869	652122	0.00	0	652122	16	104527	756651
33A310	PRIMARY ELECTRICAL SUPPLY	4781741	952222	5733963	0.00	0	5733963	17	974774	6708736
33A610	DISTRIBUTED CONTROL SYSTEM	18405	3607	22012	0.00	0	22012	18	3962	25974
33A650	COMMUNICATIONS	27348	5360	32708	0.00	0	32708	18	5887	38596
33AEZ1	OTBI NO 26 ESTIMATE ALLOWANCE	8557	1677	10234	0.00	0	10234	19	1944	12179
33AHS1	TA NO 19 ESTIMATE ALLOWANCE	69602	13642	83244	0.00	0	83244	19	15816	99060
SUBTOTAL 33A	Site Work	4905653	976508	5882161	0.00	0	5882161	17	1002383	6884545
SUBTOTAL 3	Fixed Price Construction	5450906	1083377	6534283	0.00	0	6534283	17	1106910	7641196
400000	OC Project Management - Allowance	460063	0	460063	0.00	0	460063	15	69009	529072
PROJECT TOTAL		8,577,952	1,083,377	9,661,329	0.00	0	9,661,329	17	1,606,779	11,268,111

KAISER ENGINEERS HANFORD
Westinghouse Hanford Company
JOB NO. P6P200 Z-405
FILE NO. Z405SAA3

** IEST - INTERACTIVE ESTIMATING **
Electrical Power for Phase 1 - Privatization
Study Estimate (Based on B-595 HWVP estimate)
DOE_R03 - ESTIMATE BASIS SHEET

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DATE 05/30/96 07:55:20
BY JJM

1. DOCUMENTS AND DRAWINGS

DOCUMENTS: Engineering Study - ELECTRICAL POWER FOR PHASE-I PRIVATIZATION. Rev 0. Draft A. received by Estimating 05/02/96.
B-595 HWVP Estimate.
DRAWINGS: NONE

2. MATERIAL PRICES

UNIT COSTS REPRESENT CURRENT PRICES FOR SPECIFIED MATERIAL. VENDOR INFORMATION WAS OBTAINED FOR THE FOLLOWING ITEMS: N/A

3. LABOR RATES

A.) BASE CRAFT RATES ARE AS ISSUED BY KEH FINANCE (EFFECTIVE 10-01-95). RATES INCLUDE FRINGE BENEFITS, LABOR INSURANCE, TAXES, TRAVEL,DEPARTMENTAL OVERHEADS AND G&A/SWS.
* SEE HANFORD SOFT REPORTING, FDS BUDGET GUIDELINE HANDBOOK, SECTION 2 - COMPANY INFORMATION, FY 1996 PLANNING RATES.

4. GENERAL REQUIREMENTS/TECHNICAL SERVICES/OVERHEADS

A.) ONSITE CONTRACT ADMINISTRATION AND CONSTRUCTION MANAGEMENT COSTS, ASSOCIATED WITH THE OVERALL MANAGEMENT OF THE FIXED PRICE CONTRACTS, ARE INCLUDED AS A COMPOSITE PERCENTAGE AND LUMP SUM ALLOWANCE (FOR BID PACKAGE PREP) BASED ON THE ESTIMATING FACTOR/BILLING SCHEDULE. THE TOTAL COMPOSITE PERCENTAGE AND LUMP SUM ALLOWANCE ARE APPLIED AGAINST THE TOTAL FIXED PRICE CONTRACT AMOUNT WHICH IS REFLECTED ON THE KEH SUMMARY REPORT DOE_R07, INCLUDED WITH THIS ESTIMATE. (FINAL ESTIMATES MAY BE PARTIALLY MANLOADED AND INCLUDED WITHIN THE ESTIMATE DETAIL)

B.) FIXED PRICE CONTRACTOR OVERHEAD, PROFIT, BOND AND INSURANCE COSTS HAVE BEEN APPLIED AT THE FOLLOWING PERCENTAGES AND ARE REFLECTED IN THE "OH&P/B&I" COLUMN OF THE ESTIMATE DETAIL:
LABOR - 42.7% MATERIAL - 6.5% EQUIPMENT USAGE - 6.5% EQUIPMENT - 0% SUBCONTRACTS - 0%

5. ESCALATION

ESCALATION was not included due to lack of schedule & activity timeframe.

6. ROUNDING

U.S. DEPARTMENT OF ENERGY - DOE ORDER 5100.4 PAGE I-32 SUBPARAGRAPH (M), REQUIRES ROUNDING OF ALL GENERAL PLANT PROJECTS (GPP'S) AND LINE ITEM (LI) COST ESTIMATES. REFERENCE: DOE 5100.4, FIGURE I-11, DATED 10-31-84.

7. REMARKS

A.) Estimate was based on Project B-595 (HWVP) Preliminary Estimate, Rev 'F', dated July, 1991. These costs for the substation were adjusted for a larger size substation and costs adjusted for current pricing.
B.) Contingency was applied at the same percentages as B-595 estimate.
C.) Definitive design (WBS 11) costs are an allowance based on 10% of construction and procurement costs.
D.) Field Engineering/Inspection (WBS 12) costs are an allowance based on 10% of construction and procurement costs.
E.) OC Project Management (WBS 40) costs are an allowance based on 5% of engineering, construction and procurement costs.
F.) Other Project Costs (OPC) are not included.

KAISER ENGINEERS HANFORD
Westinghouse Hanford Company
JOB NO. P6P200 Z-405
FILE NO. Z405SAA3

** IEST - INTERACTIVE ESTIMATING **
Electrical Power for Phase 1 - Privatization
Study Estimate (Based on B-595 HWVP estimate)
DOE_R04 - COST CODE ACCOUNT SUMMARY

PAGE 4 OF 8
DATE 05/30/96 07:50:13
BY JJM

COST CODE/WBS	DESCRIPTION	ESTIMATE SUBTOTAL	ONSITE INDIRECTS	SUB TOTAL	ESCALATION %	ESCALATION TOTAL	SUB TOTAL	CONTINGENCY %	CONTINGENCY TOTAL	TOTAL DOLLARS
000	Engineering									
110000	Definitive Design - Allowance	766772	0	766772	0.00	0	766772	15	115016	881788
120000	Field Engr/Inspection - Allowance	766772	0	766772	0.00	0	766772	15	115016	881788
TOTAL 000	Engineering	1533544	0	1533544	0.00	0	1533544	15	230032	1763576
060	Project Management									
400000	OC Project Management - Allowance	460063	0	460063	0.00	0	460063	15	69009	529072
TOTAL 060	Project Management	460063	0	460063	0.00	0	460063	15	69009	529072
170	Electrical Site Utilities									
33A310	PRIMARY ELECTRICAL SUPPLY	79141	15512	94653	0.00	0	94653	17	16091	110744
33A610	DISTRIBUTED CONTROL SYSTEM	2318	454	2772	0.00	0	2772	18	499	3271
33A650	COMMUNICATIONS	27348	5360	32708	0.00	0	32708	18	5887	38596
33AHS1	TA NO 19 ESTIMATE ALLOWANCE	69602	13642	83244	0.00	0	83244	19	15816	99060
TOTAL 170	Electrical Site Utilities	178409	34968	213377	0.00	0	213377	18	38293	251671
190	Final Site Work									
33AEZ1	OTBI NO 26 ESTIMATE ALLOWANCE	8557	1677	10234	0.00	0	10234	19	1944	12179
TOTAL 190	Final Site Work	8557	1677	10234	0.00	0	10234	19	1944	12179
380	HPS/DCS/MIS/ALCS Installation									
32J610	DISTRIBUTED CONTROL SYSTEM	16087	3153	19240	0.00	0	19240	18	3463	22703
33A610	DISTRIBUTED CONTROL SYSTEM	16087	3153	19240	0.00	0	19240	18	3463	22703
TOTAL 380	HPS/DCS/MIS/ALCS Installatio	32174	6306	38480	0.00	0	38480	18	6926	45406

KAISER ENGINEERS HANFORD
Westinghouse Hanford Company
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FILE NO. Z405SAA3

** IEST - INTERACTIVE ESTIMATING **
Electrical Power for Phase 1 - Privatization
Study Estimate (Based on B-595 HWVP estimate)
DOE_R04 - COST CODE ACCOUNT SUMMARY

DATE 05/30/96 07:50:13
BY JJM

COST CODE/WBS	DESCRIPTION	ESTIMATE SUBTOTAL	ONSITE INDIRECTS	SUB TOTAL	ESCALATION %	ESCALATION TOTAL	SUB TOTAL	CONTINGENCY %	CONTINGENCY TOTAL	TOTAL DOLLARS
410	Switchgear Bldg									
22JIN1	TA NO 40 ESTIMATE ALLOWANCE	315835	0	315835	0.00	0	315835	19	60009	375844
32J100	SWITCHGEAR BUILDING	330000	64680	394680	0.00	0	394680	15	59202	453882
32J320	NORMAL ELECTRICAL DISTRIBUTION	135843	26625	162468	0.00	0	162468	17	27620	190088
32J350	DC	38436	7533	45969	0.00	0	45969	19	8734	54704
32J610	DISTRIBUTED CONTROL SYSTEM	1623	318	1941	0.00	0	1941	18	349	2291
32J650	COMMUNICATIONS	10628	2083	12711	0.00	0	12711	18	2288	14999
32JIN1	TA NO 40 ESTIMATE ALLOWANCE	12636	2477	15113	0.00	0	15113	19	2871	17984
TOTAL 410	Switchgear Bldg	845001	103716	948717	0.00	0	948717	17	161073	1109792
420	HV Line & Substation									
33A310	PRIMARY ELECTRICAL SUPPLY	4702600	936710	5639310	0.00	0	5639310	17	958683	6597992
TOTAL 420	HV Line & Substation	4702600	936710	5639310	0.00	0	5639310	17	958683	6597992
P13	13.8KV Switchgear									
22J320	NORMAL ELECTRICAL DISTRIBUTION	634938	0	634938	0.00	0	634938	17	107939	742877
TOTAL P13	13.8KV Switchgear	634938	0	634938	0.00	0	634938	17	107939	742877
P14	DCS/MIS									
22J610	DISTRIBUTED CONTROL SYSTEM	182666	0	182666	0.00	0	182666	18	32880	215546
TOTAL P14	DCS/MIS	182666	0	182666	0.00	0	182666	18	32880	215546
PROJECT TOTAL		8,577,952	1,083,377	9,661,329	0.00	0	9,661,329	17	1,606,779	11,268,111

KAISER ENGINEERS HANFORD
Westinghouse Hanford Company
JOB NO. P6P200 Z-405
FILE NO. Z405SAA3

** IEST - INTERACTIVE ESTIMATING **
Electrical Power for Phase 1 - Privatization
Study Estimate (Based on B-595 HWVP estimate)
DOE_R05 - ESTIMATE SUMMARY BY CSI DIVISION

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DATE 05/30/96 07:50:21
BY JJM

CSI	DESCRIPTION	ESTIMATE SUBTOTAL	ONSITE INDIRECTS	SUB TOTAL	ESCALATION %	ESCALATION TOTAL	SUB TOTAL	CONTINGENCY %	CONTINGENCY TOTAL	TOTAL DOLLARS
	ENGINEERING									
00	Technical Services	1533544	0	1533544	0.00	0	1533544	15	230032	1763576
	TOTAL ENGINEERING	1,533,544	0	1,533,544	0.00	0	1,533,544	15	230,032	1,763,576
	CONSTRUCTION									
02	Sitework	330000	64680	394680	0.00	0	394680	15	59202	453882
16	Electrical	5630557	994141	6624698	0.00	0	6624698	17	1127591	7752291
17	Instrumentation	217158	6760	223918	0.00	0	223918	18	40305	264223
18	OTBI Estimate Allowances	8557	1677	10234	0.00	0	10234	19	1944	12179
19	Project Management	460063	0	460063	0.00	0	460063	15	69009	529072
20	Technical Allowance Estimates	398073	16119	414192	0.00	0	414192	19	78696	492888
	TOTAL CONSTRUCTION	7,044,408	1,083,377	8,127,785	0.00	0	8,127,785	17	1,376,747	9,504,535
	PROJECT TOTAL	8,577,952	1,083,377	9,661,329	0.00	0	9,661,329	17	1,606,779	11,268,111

KAISER ENGINEERS HANFORD
Westinghouse Hanford Company
JOB NO. P6P200 Z-405
FILE NO. Z405SAA3

** IEST - INTERACTIVE ESTIMATING **
Electrical Power for Phase 1 - Privatization
Study Estimate (Based on B-595 HWVP estimate)
DOE_R06 - CONTINGENCY ANALYSIS BASIS SHEET

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DATE 05/30/96 07:55:49
BY JJM

REFERENCE: ESTIMATE BASIS SHEET PAGE 3 OF 8
COST CODE ACCOUNT SUMMARY PAGE 4 & 5 OF 8

THE U.S. DEPARTMENT OF ENERGY - RICHLAND ORDER 5700.3 "COST ESTIMATING, ANALYSIS AND STANDARDIZATION" DATED 3-27-85, PROVIDES GUIDELINES FOR ESTIMATE CONTINGENCIES. THE GUIDELINE FOR A Study ESTIMATE SHOULD HAVE AN OVERALL RANGE OF 20 TO 30 %.

CONTINGENCY IS EVALUATED AT THE THIRD COST CODE LEVEL AND SUMMARIZED AT THE PRIMARY AND SECONDARY COST CODE LEVEL OF THE DETAILED COST ESTIMATE.

ENGINEERING

Contingency was allowed at 15%. Engineering costs are an allowance based on construction & procurement costs.

AVERAGE ENGINEERING CONTINGENCY 15 %

CONSTRUCTION & PROCUREMENT

Contingency percentages are the same as that which was used in the B-595 (HWVP) preliminary estimate, Rev 'F', dated July, 1991.
Procurement contingency was allowed at 18%.
Construction contingency is allowed at 17%.

AVERAGE CONSTRUCTION CONTINGENCY 17 %

OC Project Management contingency is allowed at 15%.

AVERAGE PROJECT CONTINGENCY 17 %

KAISER ENGINEERS HANFORD
Westinghouse Hanford Company
JOB NO. P6P200 Z-405
FILE NO. Z405SAA3

** IEST - INTERACTIVE ESTIMATING **
Electrical Power for Phase 1 - Privatization
Study Estimate (Based on B-595 HWVP estimate)
DOE_R07 - ONSITE INDIRECT COSTS BY WBS

PAGE 8 OF 8
DATE 05/30/96 07:50:28
BY. JJM

WBS	DESCRIPTION	ESTIMATE SUBTOTAL	CONTRACT %	ADMINISTRATION TOTAL	BID PACK PREP.	OTHER INDIRECTS	TOTAL INDIRECTS
110000	Definitive Design - Allowance	766772	0.00	0	0	0	0
120000	Field Engr/Inspection - Allowance	766772	0.00	0	0	0	0
22J320	NORMAL ELECTRICAL DISTRIBUTION	634938	0.00	0	0	0	0
22J610	DISTRIBUTED CONTROL SYSTEM	182666	0.00	0	0	0	0
22JIN1	TA NO 40 ESTIMATE ALLOWANCE	315835	0.00	0	0	0	0
32J100	SWITCHGEAR BUILDING	330000	19.60	64680	0	0	64680
32J320	NORMAL ELECTRICAL DISTRIBUTION	135843	19.60	26625	0	0	26625
32J350	DC	38436	19.60	7533	0	0	7533
32J610	DISTRIBUTED CONTROL SYSTEM	17710	19.60	3471	0	0	3471
32J650	COMMUNICATIONS	10628	19.60	2083	0	0	2083
32JIN1	TA NO 40 ESTIMATE ALLOWANCE	12636	19.60	2477	0	0	2477
33A310	PRIMARY ELECTRICAL SUPPLY	4781741	19.60	937222	15000	0	952222
33A610	DISTRIBUTED CONTROL SYSTEM	18405	19.60	3607	0	0	3607
33A650	COMMUNICATIONS	27348	19.60	5360	0	0	5360
33AEZ1	OTBI NO 26 ESTIMATE ALLOWANCE	8557	19.60	1677	0	0	1677
33AHS1	TA NO 19 ESTIMATE ALLOWANCE	69602	19.60	13642	0	0	13642
400000	OC Project Management - Allowance	460063	0.00	0	0	0	0
PROJECT TOTAL		8,577,952		1,068,377	15,000	0	1,083,377

KAISER ENGINEERS HANFORD
Westinghouse Hanford Company
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** IEST - INTERACTIVE ESTIMATING **
Electrical Power for Phase 1 - Privatization
Study Estimate (Based on B-595 HWVP estimate)
DOE_R08 - ESTIMATE DETAIL BY WBS / COST CODE

PAGE 1
DATE 05/30/96 07:50:36
BY JJM

ACCOUNT NUMBER	DESCRIPTION	COST CODE	QUANTITY	MANHOURS	LABOR	EQUIP USAGE	MATERIAL	SUB-CONTRACT	EQUIP-MENT	OH&P / B & I	TOTAL DOLLARS
110000	Definitive Design - Allowance										
110000.00	Technical Services										
110000.0001001	Definitive Design Allowance allow 10% of Construction cost	000	1 ls	0	0	0	766772	0	0	0	766772
SUBTOTAL	Technical Services			0	0	0	766.772	0	0	0	766.772
TOTAL	COST CODE 00000 WBS 110000 (ESCALATION 0.00% - CONTINGENCY 15.00 %)			0	0	0	766.772	0	0	0	766.772
TOTAL WBS 110000	Definitive Design - Allowance			0	0	0	766.772	0	0	0	766.772

KAISER ENGINEERS HANFORD
Westinghouse Hanford Company
JOB NO. P6P200 Z-405

** IEST - INTERACTIVE ESTIMATING **
Electrical Power for Phase 1 - Privatization
Study Estimate (Based on B-595 HWVP estimate)
DOE_R08 - ESTIMATE DETAIL BY WBS / COST CODE

PAGE 2
DATE 05/30/96 07:50:36
BY JJM

ACCOUNT NUMBER	DESCRIPTION	COST CODE	QUANTITY	MANHOURS	LABOR	EQUIP USAGE	MATERIAL	SUB-CONTRACT	EQUIP-MENT	OH&P / B & I	TOTAL DOLLARS
120000	Field Engr/Inspection - Allowance										
120000.00	Technical Services										
120000.0001003	Field Engr/Inspect Allowance allow 10% of Construction cost	000	1 ls	0	0	0	766772	0	0	0	766772
SUBTOTAL	Technical Services			0	0	0	766,772	0	0	0	766,772
TOTAL	COST CODE 00000 WBS 120000 (ESCALATION 0.00% - CONTINGENCY 15.00 %)			0	0	0	766,772	0	0	0	766,772
TOTAL WBS 120000 Field Engr/Inspection - Allowance				0	0	0	766,772	0	0	0	766,772

KAISER ENGINEERS HANFORD
Westinghouse Hanford Company
JOB NO. P6P200 Z-405

** IEST - INTERACTIVE ESTIMATING **
Electrical Power for Phase 1 - Privatization
Study Estimate (Based on B-595 HWVP estimate)
DOE_R08 - ESTIMATE DETAIL BY WBS / COST CODE

PAGE 3
DATE 05/30/96 07:50:36
BY JJM

ACCOUNT NUMBER	DESCRIPTION	COST CODE	QUANTITY	MANHOURS	LABOR	EQUIP USAGE	MATERIAL	SUB-CONTRACT	EQUIP-MENT	OH&P / B & I	TOTAL DOLLARS
22J320	NORMAL ELECTRICAL DISTRIBUTION										
22J320.16 22J320.1661GF1	Electrical SG-32A-001 NORMAL 13.8 KV SWITCHGEAR	P13	1 LOT	0	0	0	498800	0	0	2414	501214
SUBTOTAL	Electrical			0	0	0	498.800	0	0	2.414	501.214
	SALES TAX 8.00 %						39904		0		39904
	WAREHOUSING 18.68 %						93175				93175
	OH&P (ON MARKUPS ONLY)									644	644
TOTAL	COST CODE P1316 WBS 22J320 (ESCALATION 0.00% - CONTINGENCY 17.00 %)			0	0	0	631.879	0	0	3.058	634.937
TOTAL WBS 22J320 NORMAL ELECTRICAL DISTRIBUTION				0	0	0	631.879	0	0	3.058	634.937

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ACCOUNT NUMBER	DESCRIPTION	COST CODE	QUANTITY	MANHOURS	LABOR	EQUIP USAGE	MATERIAL	SUB-CONTRACT	EQUIP-MENT	OH&P / B & I	TOTAL DOLLARS
22J610	DISTRIBUTED CONTROL SYSTEM										
22J610.17	Instrumentation										
22J610.1771G09	DCS HARDWARE	P14	1 LOT	0	0	0	143500	0	0	695	144195
SUBTOTAL	Instrumentation			0	0	0	143,500	0	0	695	144,195
	SALES TAX 8.00 %						11480		0		11480
	WAREHOUSING 18.68 %						26805				26805
	OH&P (ON MARKUPS ONLY)									185	185
TOTAL	COST CODE P1417 WBS 22J610 (ESCALATION 0.00% - CONTINGENCY 18.00 %)			0	0	0	181.785	0	0	880	182.666
TOTAL WBS 22J610 DISTRIBUTED CONTROL SYSTEM				0	0	0	181.785	0	0	880	182.666

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ACCOUNT NUMBER	DESCRIPTION	COST CODE	QUANTITY	MANHOURS	LABOR	EQUIP USAGE	MATERIAL	SUB-CONTRACT	EQUIP-MENT	OH&P / B & I	TOTAL DOLLARS
22JIN1	TA NO 40 ESTIMATE ALLOWANCE										
22JIN1.20 22JIN1.20BN001	Technical Allowance Estimates TA-40 EST ALLOW ELECT DIST MICROPROCESSOR MONTORING SYST	410	1 LOT	0	0	0	234100	0	0	15217	249317
SUBTOTAL	Technical Allowance Estimates			0	0	0	234.100	0	0	15.217	249.317
	SALES TAX 8.00 %						18728		0		18728
	WAREHOUSING 18.68 %						43729				43729
	OH&P (ON MARKUPS ONLY)									4059	4059
TOTAL	COST CODE 41020 WBS 22JIN1 (ESCALATION 0.00% - CONTINGENCY 19.00 %)			0	0	0	296.557	0	0	19.276	315.834
TOTAL WBS 22JIN1 TA NO 40 ESTIMATE ALLOWANCE				0	0	0	296.557	0	0	19.276	315.834

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ACCOUNT NUMBER	DESCRIPTION	COST CODE	QUANTITY	MANHOURS	LABOR	EQUIP USAGE	MATERIAL	SUB-CONTRACT	EQUIP-MENT	OH&P / B & I	TOTAL DOLLARS
32J100	SWITCHGEAR BUILDING										
32J100.02	Sitework										
32J100.0222001	Swgr Building allowance w/Elect/Mech/HVAC/Fire Sys.	410	1500 sf	0	0	0	0	300000	0	30000	330000
SUBTOTAL	Sitework			0	0	0	0	300,000	0	30,000	330,000
TOTAL	COST CODE 41002 WBS 32J100 (ESCALATION 0.00% - CONTINGENCY 15.00 %)			0	0	0	0	300,000	0	30,000	330,000
TOTAL WBS 32J100 SWITCHGEAR BUILDING				0	0	0	0	300,000	0	30,000	330,000

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ACCOUNT NUMBER	DESCRIPTION	COST CODE	QUANTITY	MANHOURS	LABOR	EQUIP USAGE	MATERIAL	SUB-CONTRACT	EQUIP-MENT	OH&P / B & I	TOTAL DOLLARS
32J320	NORMAL ELECTRICAL DISTRIBUTION										
32J320.16	Electrical										
32J320.1661151	SG-32A-001	410	1 EA	769	26500	2831	0	0	0	11500	40831
	NORMAL 13.8 KV SWITCHGEAR										
32J320.1661186	XT-32A-008	410	1 LOT	50	1723	184	2900	0	0	936	5743
	TRANSFORMER & LTG/RCPT PNLS										
32J320.1662C06	2" PVC SCH 80 CONDUIT, U/G	410	220 LF	20	685	46	200	0	0	308	1239
32J320.1662C09	4" PVC SCH 80 CONDUIT, U/G	410	290 LF	55	1884	123	768	0	0	862	3637
32J320.1662C10	5" PVC SCH 80 CONDUIT, U/G	410	460 LF	114	3906	258	1757	0	0	1799	7720
32J320.1662D06	2" COND CONN, N-HAZ, U/G	410	10 EA	18	617	41	145	0	0	276	1079
32J320.1662D09	4" COND CONN, N-HAZ, U/G	410	16 EA	67	2295	152	901	0	0	1048	4396
32J320.1662D10	5" COND CONN, N-HAZ, U/G	410	8 EA	41	1405	92	795	0	0	658	2950
32J320.1662L08	1/C # 1 STR CU XHHW	410	9570 LF	163	5584	364	6814	0	0	2851	15613
	600 V										
32J320.1662T68	1/C # 1 WIRE TERMINATION	410	12 EA	4	137	9	0	0	0	59	205
32J320.1663C83	1" IMC CONDUIT W/ 2 FTGS	410	90 LF	13	445	30	91	0	0	198	764
32J320.1663D43	1" COND CONN, N-HAZ, A/G	410	2 EA	3	103	6	12	0	0	45	166
32J320.1663L22	1/C # 12 STR CU XHHW	410	130 LF	2	69	4	12	0	0	31	116
	600 V										
32J320.1663L25	1/C # 6 STR CU XHHW	410	400 LF	6	206	14	93	0	0	95	408
	600 V										
32J320.1663T65	1/C # 6 WIRE TERMINATION	410	6 EA	2	69	4	0	0	0	30	103
32J320.1663W56	36" CABLE TRAY, L/T	410	160 LF	39	1336	88	14560	0	0	1523	17507
	STR SECT, W/O CVR										
32J320.1663W66	36" CABLE TRAY, L/T	410	4 EA	25	857	56	338	0	0	392	1643
	ELB, 90D HZ, W/O CVR										
32J320.1663W96	36" CABLE TRAY, L/T	410	1 EA	9	308	20	160	0	0	143	631
	TEE, 24" R, W/O CVR										
32J320.1663Z26	36" TRAY, BLIND END	410	2 EA	3	103	6	15	0	0	45	169
32J320.1663Z28	STRAIGHT BARRIER STRIP	410	160 LF	34	1165	76	288	0	0	521	2050
32J320.1663Z30	FLEX BARRIER STRIP	410	20 LF	5	171	12	51	0	0	77	311
32J320.1666Z10	LIGHTING ALLOWANCE	410	1500 sf	150	5139	0	3000	0	0	2389	10528
	SWGR BLDG										
32J320.1669G11	EQUIPMENT GROUNDING	410	1 ls	200	6852	800	4000	0	0	3238	14890
	(ALLOWANCE)										
SUBTOTAL	Electrical			1,792	61,559	5,216	36,900	0	0	29,024	132,699
	SALES TAX 8.00 %						2952		0		2952
	OH&P (ON MARKUPS ONLY)									191	191
TOTAL	COST CODE 41016 WBS 32J320			1,792	61,559	5,216	39,852	0	0	29,215	135,842

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ACCOUNT NUMBER	DESCRIPTION	COST CODE	QUANTITY	MANHOURS	LABOR	EQUIP USAGE	MATERIAL	SUB-CONTRACT	EQUIP-MENT	OH&P / B & I	TOTAL DOLLARS
	(ESCALATION 0.00% - CONTINGENCY 17.00 %)										
TOTAL WBS 32J320 NORMAL ELECTRICAL DISTRIBUTION				1,792	61,559	5,216	39,852	0	0	29,215	135,842

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ACCOUNT NUMBER	DESCRIPTION	COST CODE	QUANTITY	MANHOURS	LABOR	EQUIP USAGE	MATERIAL	SUB-CONTRACT	EQUIP-MENT	OH&P / B & I	TOTAL DOLLARS
32J350	DC										
32J350.16	Electrical										
32J350.1661010	BA-35A-401 BATTERY, CONTROL (SWGR BLDG)	410	1 EA	141	4859	518	13600	0	0	2992	21969
32J350.1661023	BC-35A-401 BATTERY CHARGER (SWGR BLDG)	410	1 EA	32	1103	118	3700	0	0	719	5640
32J350.1661073	DX-35A-401 DISTR PANEL, DC (SWGR BLDG)	410	1 EA	32	1103	118	1400	0	0	570	3191
32J350.1663C82	3/4" IMC CONDUIT W/ 2 FTGS	410	130 LF	14	480	32	99	0	0	213	824
32J350.1663C85	1-1/2" IMC CONDUIT W/ 2 FTGS	410	70 LF	13	445	29	111	0	0	199	784
32J350.1663D42	3/4" COND CONN, N-HAZ, A/G	410	4 EA	3	103	7	14	0	0	45	169
32J350.1663D45	1-1/2" COND CONN, N-HAZ, A/G	410	8 EA	14	480	33	86	0	0	213	812
32J350.1663L22	1/C # 12 STR CU XHHW 600 V	410	700 LF	8	274	19	64	0	0	122	479
32J350.1663L25	1/C # 6 STR CU XHHW 600 V	410	150 LF	2	69	5	35	0	0	32	141
32J350.1663L30	1/C #2/0 STR CU XHHW 600 V	410	460 LF	15	514	35	472	0	0	252	1273
32J350.1663T62	1/C # 12 WIRE TERMINATION	410	32 EA	7	240	15	0	0	0	103	358
32J350.1663T65	1/C # 6 WIRE TERMINATION	410	8 EA	3	103	6	0	0	0	44	153
32J350.1663T70	1/C #2/0 WIRE TERMINATION	410	24 EA	19	651	43	0	0	0	281	975
SUBTOTAL	Electrical			303	10,424	978	19,581	0	0	5,785	36,768
	SALES TAX 8.00 %						1566		0		1566
	OH&P (ON MARKUPS ONLY)									101	101
TOTAL	COST CODE 41016 WBS 32J350 (ESCALATION 0.00% - CONTINGENCY 19.00 %)			303	10,424	978	21,147	0	0	5,886	38,436
TOTAL WBS 32J350 DC				303	10,424	978	21,147	0	0	5,886	38,436

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ACCOUNT NUMBER	DESCRIPTION	COST CODE	QUANTITY	MANHOURS	LABOR	EQUIP USAGE	MATERIAL	SUB-CONTRACT	EQUIP-MENT	OH&P / B & I	TOTAL DOLLARS
32J610	DISTRIBUTED CONTROL SYSTEM										
32J610.16	Electrical										
32J610.1663C92	3/4" IMC CONDUIT W/ 4 FTGS	410	100 LF	13	445	30	84	0	0	197	756
32J610.1663D42	3/4" COND CONN. N-HAZ. A/G	410	4 EA	3	103	7	14	0	0	45	169
32J610.1663L22	1/C # 12 STR CU XHHW 600 V	410	730 LF	9	308	20	66	0	0	137	531
32J610.1663T62	1/C # 12 WIRE TERMINATION	410	12 EA	3	103	6	0	0	0	44	153
SUBTOTAL	Electrical			28	959	63	164	0	0	423	1,609
	SALES TAX 8.00 %						13		0		13
	OH&P (ON MARKUPS ONLY)									0	0
TOTAL	COST CODE 41016 WBS 32J610 (ESCALATION 0.00% - CONTINGENCY 18.00 %)			28	959	63	177	0	0	423	1,622
32J610.17	Instrumentation										
32J610.1771006	DCS HARDWARE	380	1 LOT	303	10441	1115	0	0	0	4531	16087
SUBTOTAL	Instrumentation			303	10,441	1,115	0	0	0	4,531	16,087
TOTAL	COST CODE 38017 WBS 32J610 (ESCALATION 0.00% - CONTINGENCY 18.00 %)			303	10,441	1,115	0	0	0	4,531	16,087
TOTAL WBS 32J610 DISTRIBUTED CONTROL SYSTEM				331	11,400	1,178	177	0	0	4,954	17,709

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ACCOUNT NUMBER	DESCRIPTION	COST CODE	QUANTITY	MANHOURS	LABOR	EQUIP USAGE	MATERIAL	SUB-CONTRACT	EQUIP-MENT	OH&P / B & I	TOTAL DOLLARS
32J650	COMMUNICATIONS										
32J650.16	Electrical										
32J650.1668T30	TELEPHONE SYSTEM: INC'L PHONE SETS, CONDUIT, CABLE & TERM. BOX	410	1 ls	180	6167	0	1589	0	0	2737	10493
SUBTOTAL	Electrical			180	6,167	0	1,589	0	0	2,737	10,493
	SALES TAX 8.00 %						127		0		127
	OH&P (ON MARKUPS ONLY)									8	8
TOTAL	COST CODE 41016 WBS 32J650 (ESCALATION 0.00% - CONTINGENCY 18.00 %)			180	6,167	0	1,716	0	0	2,745	10,628
TOTAL WBS 32J650 COMMUNICATIONS				180	6,167	0	1,716	0	0	2,745	10,628

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ACCOUNT NUMBER	DESCRIPTION	COST CODE	QUANTITY	MANHOURS	LABOR	EQUIP USAGE	MATERIAL	SUB-CONTRACT	EQUIP-MENT	OH&P / B & I	TOTAL DOLLARS
32JIN1	TA NO 40 ESTIMATE ALLOWANCE										
32JIN1.20	Technical Allowance Estimates										
32JIN1.20BN002	TA-40 EST ALLOW ELECT DIST MICROPROCESSOR MONTORING SYST	410	1 LOT	238	8201	876	0	0	0	3559	12636
SUBTOTAL	Technical Allowance Estimates			238	8,201	876	0	0	0	3,559	12,636
TOTAL	COST CODE 41020 WBS 32JIN1 (ESCALATION 0.00% - CONTINGENCY 19.00 %)			238	8,201	876	0	0	0	3,559	12,636
TOTAL WBS 32JIN1 TA NO 40 ESTIMATE ALLOWANCE				238	8,201	876	0	0	0	3,559	12,636

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Revision 0

Engineering Study for the Phase I Privatization Facilities Electrical Power

Prepared for the U.S. Department of Energy
Office of Environmental Restoration and
Waste Management

Westinghouse Hanford Company Richland, Washington

Management and Operations Contractor for the
U.S. Department of Energy under Contract DE-AC06-87RL10930

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