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Office of Nuclear Reactor Regulation, Director

SUBJECT: Forwards reanalysis of adequacy of facility electric distribution sys voltages,per 830831 confirmatory action ltr.Reanalysis establishes allowable ranges of switchyard voltages for operation.Methodology described in 830926 ltr.

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December 30, 1983

Director
Office of Nuclear Reactor Regulation
U S Nuclear Regulatory Commission
Washington, DC 20555

MONTICELLO NUCLEAR GENERATING PLANT
Docket No. 50-263 License No. DPR-22

Re-analysis of Adequacy of Station Electric
Distribution System Voltages

In a Region III Confirmatory Action Letter dated August 31, 1983 Northern States Power Company was requested to perform a re-analysis of the adequacy of station electric distribution system voltages. A description of the methodology to be employed in this re-analysis was contained in our letter dated September 26, 1983. The purpose of the re-analysis is to establish allowable ranges of switchyard voltages for operation of the Monticello Nuclear Generating Plant. The original analysis performed in 1981 is unsuitable for this purpose.

Attached for NRC Staff review is the revised analysis. Minimum and Maximum acceptable switchyard and safeguards bus voltages are reported in Section 3.3 of the report. To obtain optimum range of acceptable voltage, replacement of degraded voltage relays with a type having a smaller deadband is assumed. In addition, the analysis takes credit for tap changes on the 120-volt instrument transformers which were found to be desireable. These changes, as well as changes in diesel generator starting logic to minimize unloaded operation and changes in the degraded voltage protection logic to allow transfer to the alternate offsite source prior to transfer to the diesel generators will be completed during the 1984 refueling outage. In conjunction with these changes, an increase in the Technical Specification degraded voltage protection logic setpoints will be requested in a License Amendment Request to be submitted prior to March 1, 1984.

Details of the design changes described in this report should be available for the information of the Staff by April 30, 1984. All changes, with the exception of the change in degraded voltage protection logic setpoint, are planned for accomplishment under the provisions of 10 CFR Part 50, Section 50.59 without prior NRC approval.

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If there are any questions related to the attached analysis we would be happy to meet with members of the Staff in Bethesda at a convenient time.

Until NRC review of our new analysis is completed, we believe the interim procedures and analyses described in our letters dated August 24, 1983, September 9, 1983, October 14, 1983 and October 28, 1983 provide assurance that adequate distribution system voltages will be maintained at the Monticello Nuclear Generating Plant.

David Musolf
Manager - Nuclear Support Services

DMM/bd

c: Regional Administrator - II
NRR Project Manager, NRC
Resident Inspector, NRC
G Charnoff
J F Streeter, Region III, NRC

Attachment

NORTHERN STATES POWER COMPANY
MONTICELLO NUCLEAR GENERATING PLANT

STATION ELECTRIC DISTRIBUTION SYSTEM VOLTAGE ANALYSIS

1. SUMMARY AND CONCLUSIONS

This analysis was prepared in response to a Confirmatory Action Letter dated August 31, 1983 from Mr. James G. Keppler, Regional Administrator, Region III Office, USNRC. We were requested to submit a revision of our January 30, 1981 analysis of the adequacy of our station electric distribution system to NRR by December 31, 1983. The re-analysis followed the guidelines established in our September 26, 1983 letter - Proposed Procedure for Re-analysis of Adequacy of Station Electric Distribution System Voltages - to the Office of Nuclear Reactor Regulation.

The revised analysis techniques differed from those previously, in that:

A. The computer model used in the analysis of the auxiliary distribution system was refined from actual test data, voltage measurements and operational considerations.

B. Minimum plant load was decreased.

C. Maximum plant load was increased.

The Computer Analysis established operating ranges (see table below) for the sources to maintain acceptable voltage levels on all the essential buses. These operating ranges are dependent upon plant loading conditions and do not imply safety limits. They take into account tap changes on the 120 volt instrument transformers and narrower degraded voltage relay dead band than experienced with the existing relays.

OPERATING RANGES

	Hi	Lo
115 Kv	122	117.5
345 Kv	362	340
Generator Terminal Volt.	22.5	21.3
4.16 Kv Bus	4375	3989

3897 volts was established as the voltage necessary on the essential safeguards buses No. 15 and No. 16 to maintain the minimum allowable on the 120 volt instrument buses with:

A. Full station auxiliary load
B. ECCS actuation
C. Load shed per plant design

A review of the degraded voltage protection logic scheme concluded that changes are warranted. These changes would involve transfer to an alternate offsite source on sensing degraded conditions rather than going directly to the diesel generators.

Changes will be made to the diesel start logic to reduce the number of unnecessary starts. These changes will ultimately reduce the no-load running time on the diesels.

2. DESCRIPTION OF STATION ELECTRIC DISTRIBUTION SYSTEM AND OFF-SITE SOURCES

2.1 Essential Buses

All station power is supplied by the 4.16 KV station auxiliary system. Large motors are supplied directly from this system. Other loads are supplied indirectly through transformers, motor generators, or battery systems charged from the ac distribution system.

There are two essential 4.16 KV buses. These are the buses numbered 15 and 16. One division of safety related equipment is powered from each of these buses.

2.2 Power Sources

There are two primary sources of power for the 4.16 KV distribution system, No. 11 Auxiliary Transformer and No. 1R Reserve Transformer. In addition, the 15 and 16 essential 4 KV buses can be supplied directly by the No. 1AR Transformer or by their respective on-site emergency diesel generator.

The No. 11 Station Auxiliary Transformer is a 21.7 Kv - 4.16Kv - 4.16Kv, 38,000 Kva transformer with dual low voltage windings. The transformer high voltage winding is connected to the generator terminals through isophase bus duct and the low voltage windings are connected to the 4.16Kv station auxiliary switchgear through non-segregated phase bus duct. See Figure 1, Diagram GF-1660.

The low voltage winding designated "X" supplies power to the large motor buses No. 11 and No. 12 while the low voltage winding designated "Y" supplies power to No. 13 and No. 14 buses which in turn supply power to the ECCS buses No. 15 and No. 16 respectively.

The No. 11 Station Auxiliary Transformer is connected delta-wye with high resistance grounded wye neutrals to limit available ground fault current to the 4.16 Kv switchgear.

The exclusive purpose of No. 11 Station Auxiliary Transformer is to supply the unit station auxiliary loads during unit operation. Protective relaying for No. 11 Station Auxiliary Transformer consists of transformer differential, sudden pressure, and ground overcurrent relaying. Operation of any one of the protective relays will trip the auxiliary transformer lockout relay which in turn trips No. 1 Generator lockout relay. Operation of the No. 1 Generator lockout relay will simultaneously trip the generator gas circuit breakers, turbine master trip solenoids, generator field breaker and initiate an automatic fast (break before make) transfer of the station auxiliary loads to No. 1 Reserve Station Auxiliary Transformer.

In addition to the aforementioned protective relaying, transformer winding temperature, transformer oil temperature, and transformer oil level indicators with alarm contacts are provided.

No. 1 Reserve Station Auxiliary Transformer is a 115Kv - 4.16Kv - 4.16Kv, 37,333 Kva transformer with dual low voltage windings. The transformer high voltage winding is connected to the 115Kv substation bus through a 115Kv gang operated disconnect switch and overhead transmission line. The low voltage windings are connected to the 4.16Kv switchgear through non-segregated phase bus duct. The low voltage winding designated "X" supplies power to the large motor buses No. 11 and No. 12, while the "Y" winding supplies power to bus No. 13 and No. 14 which in turn supply power to the ECCS buses No. 15 and 16 respectively

The No. 1 Reserve Station Auxiliary Transformer is connected wye-wye with high resistance grounded wye neutrals on the 4.16 Kv windings to limit available ground fault current to the switchgear.

No. 1 Reserve Station Auxiliary Transformer is intended to supply the unit station auxiliary loads during unit startup, unit shutdown, or whenever otherwise required. Protective relaying for No. 1 Reserve Station Auxiliary Transformer consists of transformer differential, sudden pressure, ground overcurrent, and backup overcurrent relays. Operation of any one of the protective relays will trip the transformer lockout relay which will trip the 115Kv substation source breakers to No.1 Reserve Station Auxiliary Transformer as well as the 4.16Kv air circuit breakers connected to the low voltage windings, and also initiate a start of the emergency diesels. Station auxiliary loads being supplied by No. 1 Reserve Station Auxiliary Transformer will be de-energized. Only 4.16 Kv buses No. 15 and No. 16 (ECCS) will be automatically re-energized by No. 1 AR Transformer or the emergency diesel generators. All other station auxiliary loads will be without a source of power.

In addition to the aforementioned protective relays, transformer winding temperature, transformer oil temperature, and transformer oil level indicators with alarm contacts are provided.

No. 1 AR Reserve Station Auxiliary Transformer is a 13.8 Kv - 4.16Kv, 7500 KVA transformer. The transformer high voltage winding is energized from the tertiary winding of No. 10 transformer (345 KV-115KV) through 13.8Kv air circuit breaker 1N2. The low voltage winding is connected to 4.16Kv safeguard buses 15 and 16 through 4.16 Kv air circuit breakers 152-511 and 152-610 respectively.

The No. 1 AR Reserve Station Auxiliary Transformer is connected delta-wye with ground transformer attached to wye neutral.

This transformer provides backup off-site power for 4.16 KV safeguard buses 15 and 16 in event of loss of voltage on the 4.16 KV side of 1R station auxiliary transformer. Because of the limited capacity of the 1AR transformer (7500 KVA) only the safeguards buses are transferred to this transformer. This transformer has no cooling fans or oil pumps.

Protective relaying for No. 1 AR Reserve Station Auxiliary Transformer consists of transformer differential, overcurrent and ground detection. Operation of any one of the protective relays will trip the transformer lockout relay which will trip the 13.8 KV substation breaker to No. 1 AR Reserve Station Auxiliary Transformer as well as the 4.16 Kv air circuit breakers connected to the low voltage winding, and also initiate a start of the emergency diesels.

The diesel engine-generator units are a standard design with engine, generator, electrical controls and auxiliaries all mounted on a common base. Output is rated at 2500 kW (3125 KVA @ .8PF), 4160V, three phase, 60 Hz ac. Protective relays are provided to prevent loading the generator until the diesel engine has accelerated to operating speed. Voltage and speed regulators are provided as well as overload alarms. Overloads or ground faults do not cause automatic trip out of the generator circuit breakers. Operators will adjust loads if the overload alarm indicates a need. The diesel generators are rated for 10% overload for 2000 hours or 22% overload for 30 minutes out of each 24 hours. Protective relays initiate tripping of the generator circuit breakers and the engine for differential overcurrent, phase fault or reverse power. An automatic overspeed trip device is the only mechanical device which will trip the diesel engine.

The generators are Y connected with the neutral of each grounded through special transformers with ground current monitors provided. Voltmeters, ammeters, and wattmeters are provided to permit monitoring the loading of each unit. Equipment is provided for manually synchronizing the generators with the incoming a-c power lines for operational and test purposes. Automatic synchronization is not provided. Each diesel generator unit is so loaded and of such capacity that, even if only one unit operates, safe shutdown of the reactor is assured, even under design basis accident conditions.

Each diesel generator is designed to start automatically, and within 10 seconds begin to accept sequenced load (see 2.4.4). As shown in this section, pump motors are started at five second intervals. The diesel generator and its control system are designed to maintain output voltage above 70% of rated voltage upon the application of any of these pump motor loads including the running load at the instant of connecting each successive load. Voltage will be restored to within 87% in 1 second and 98% within 1.7 seconds.

The diesel generators are each capable of starting and carrying the largest vital loads required under postulated accident conditions. After the automatic start sequence is complete, the generator may be manually loaded to its rated capacity at the discretion of the operator. Alarms are provided which will annunciate an overloaded condition; however, the generator load will not trip when the generator becomes overloaded. Operator action will correct the overload condition.

Although an automatic start of the diesel generator has been initiated, there may have been no loss of voltage on the essential buses, or an automatic transfer to another source may have been effected, in which case the running generators are held in reserve during the emergency period. Manual control is then employed for additional load switching.

If the essential buses are still de-energized when the diesels have accelerated, automatic relaying will remove unnecessary loads and disconnect the essential buses from the normal auxiliary system. If a loss-of-coolant accident condition is indicated, core spray and RHR systems are started. These pumps are sequenced on in order to prevent stalling of the diesel engine. After automatic actions have been completed, the operator may add other loads within the capacity of the generators.

Tables 1 and 1A summarizes the ratings of transformers supplying power to the 4KV and 480V buses. Table 2 & 3 summarizes the loads on each of the buses. Impedances are shown in table 4.

A one line diagram showing the arrangement of the Monticello station auxiliary system and substation is provided in figures 1 and 2.

2.3 Auxiliary Power Transfer

Two automatic transfer schemes control the transfer of station auxiliary power from No. 11 Station Auxiliary Transformer to No. 1 Reserve Station Auxiliary Transformer. A "make before break" or "closed" transfer occurs upon actuation of the turbine lockout relay if substation breakers 8N4 and/or 8N5 are closed, the generator lockout relay is not tripped, and if the generator negative sequence is not tripped. A "break before make" or "open-fast" transfer occurs for either of the following:

1. Actuation of the generator lockout relay.
2. Actuation of the generator negative sequence relay combined with a turbine lockout.

This prevents closing the 1R transformer onto a fault.

Both automatic transfers will also start the diesel generators and trip the reactor recirculation pump MG drive motor breakers.

The initiating causes for turbine or generator lockouts and types of automatic transfers are listed:

Initiating Cause for Generator Lockout	Type of Automatic Transfer
Generator Emergency Trip	Open
Generator Neutral Overvoltage	Open
Generator Transformer Sudden Pressure	Open
Generator Differential	Open
Main Transformer and Generator Differential	Open
345Kv Substation Relaying	Open
11 Station Aux Transformer Lockout	Open
Generator Overcurrent	Open
Turbine Lockout with Gen. Negative Sequence	Open

Initiating Cause for Turbine Lockout	Type of Automatic Transfer
Turbine Emergency Trip	Closed
Moisture Separator High Level	Closed
Turbine Thrust Wear	Closed
Turbine Exhaust Hood Temperature	Closed
Turbine High Vibration	Closed

Initiating Cause for Turbine Lockout	Type of Automatic Transfer
Condenser Vacuum Low	Closed
Generator Loss of Field	Closed
Loss of Generator Stator Cooling	Closed
Reactor High Water Level	Closed

2.4 Essential Bus Transfer

Essential buses 15 and 16 are provided with two transfer schemes, one of which controls automatic transfer to the 1AR transformer and another which controls automatic transfer to the associated diesel generator. Bus transfer logic setpoints are summarized on Table 6.

2.4.1 Transfer to the 1AR Transformer

If the 1AR breaker control switch is in "auto", voltage is present on the 1AR secondary, and transfer to the diesel generator has not been initiated (see 2.4.2 below), transfer to the 1AR will occur with either one of the following:.

1. Loss of 4 KV voltage on the 1R transformer while supplying 15 or 16 buses.
2. Loss of voltage on the essential bus which persists for greater than five seconds.

The transfer relays in this scheme will strip the 4.16 KV essential bus of all loads except the associated 480 volt load center and will also strip that load center of all non-essential motor control centers (MCC's). Concurrently, these relays initiate a 15-cycle-delayed closure of the 1AR supply breaker to the essential bus.

2.4.2 Transfer to the Diesel Generator

Transfer to the associated diesel generator is initiated by the automatic opening of all 4.16 KV source breakers to the essential bus as a result of one of the following:

1. Loss of 4 KV voltage on the 1AR transformer while supplying 15 and 16 buses.
2. Loss of voltage on the essential bus which persists for greater than 10 seconds.
3. Degraded voltage on the essential bus for greater than 10 seconds.

NOTE: A loss of voltage automatically blocks action by the degraded voltage logic

Automatic loading of the diesel generator will occur if the diesel generator 4.16KV breaker control switch is in "auto" and diesel generator voltage is within 10% of rated, and the load shed is completed.

The transfer relays in this scheme will strip the 4.16 KV essential bus of all loads except the associated 480 volt load center and will also strip that load center of all non-essential MCC's.

Automatic starting of the diesel generators occurs on operation of lockout relays for the turbine, generator, 1R transformer, or 1AR transformer; loss of voltage on the essential buses; low voltage on the 1AR secondary; opening of normal essential bus supply breakers; or an ECCS actuation signal.

2.4.3 ECCS Load Shedding

If power to an essential 4.16 KV bus is not being supplied by it's normal source (i.e. bus 13 or 14) and if the Core Spray system is initiated, relays within the Core Spray logic will act to shed loads from the essential 4.16KV and 480V buses. In the case of the 4.16 KV equipment this shedding is redundant to that performed during the bus transfers described above except for the additional shed of the cooling tower pumps and fans. In the case of the 480V equipment this shedding is unique to the ECCS load shedding scheme. Loads are locked out as long as both RHR pumps on the essential bus in question are running and the bus is not being supplied by its normal source.

The loads which are shed by this scheme are as follows:

Instrument and Service Air Compressor
Control Rod Drive Pumps
Drywell Cooling Recirc Fans
Residual Heat Removal (RHR) Service Water Pumps
Fuel Pool Cooling Pump
Service Water Pump
Reactor Building Closed Cooling Water Pump

2.4.4 Automatic Sequencing of ECCS Loads

If there is an ECCS initiation, the starting of the RHR and Core Spray pumps are sequenced to limit the maximum motor starting load. The time delays employed are as follows:

Time	Essential Bus 15	Essential Bus 16
5 seconds	RHR Pump A	RHR Pump B
10 seconds	RHR Pump C	RHR Pump D
15 seconds	Core Spray Pump A	Core Spray Pump B

3. Voltage Analysis

3.1 Assumptions Used in the Analysis

Input to the voltage analysis required a definition of the maximum, minimum and LOCA auxiliary load conditions for the plant. The loading was calculated by listing all loads in the plant and determining the expected coincident load demand based on plant design and operating procedures. The following assumptions were used in calculating the coincident demand load:

- measured currents were used for continuously running motors. If these were not available, calculated horsepower or nameplate currents were used.

- for lighting panels, the measured current was used where it appeared reasonable. Where measured current appeared low compared to the rated current of the transformer, higher loads were assumed, typically 80% of the rating.

- where redundant or multiple motors are provided, a demand factor reflecting the operating horsepower was applied . For example, if two full capacity pumps are provided, but only one of the two is normally operating, then a demand factor of 0.50 was applied.

- a demand factor of 0.25 was applied to intermittent loads such as sump pumps, drain pumps, air compressors etc.

- where the connected load consists of a combination of heating and cooling loads, the cooling load was used for the maximum house load condition, and the heating load was used for the minimum load conditions.

- all motor-operated valve loads were excluded because of their short duty cycle.

Using the above technique, total loads on each MCC, load center and 4KV bus were calculated and used for the load distribution in a load flow computer program.

Acceptable voltage limits on the essential 120 VAC instrument panels were assumed to be 120 VAC ± 10% based on typical vendor specifications. Voltage drop in the 120 VAC cable runs were assumed to be negligable because of the light loads in the instrument circuits. The instrument transformers were assumed to be at the optimum tap setting of 456 VAC/120 VAC.

Acceptable voltage limits on the 480 VAC MCC's were based on the connected loads. An upper value of 496VAC was derived from a limit of +10% at the 440 Volt motor terminals plus 2.5% for cable drop from the MCC. A lower value of 426 VAC was based on a limit of -10% at the 460 volt motor terminals plus 2.5% for cable drop from the MCC. The instrument AC levels would stay within 120 VAC ±10% with these 480 VAC limits. Also, based on previous testing, the motor starters would operate with MCC voltages at the low limit.

For the analysis, it was assumed new degraded voltage protection relays were installed. The manufacturer's specified reset band for the new relays is 42 volts. A setting range of ± 18 volts was assumed.

Operating range of the 345 KV system was derived from actual test data on the load tap changer of No. 10 transformer. The minimum and maximum unloaded No. 1 AR transformer voltages and corresponding tap positions were reflected back to the 345 KV system to establish the operating range.

3.2 Analysis Technique

The plant electrical distribution system was modeled on an NSP computer. The computer program uses the Newton-Raphson iterative program for load flow analysis. Various cases were then run using the calculated load distribution for the LOCA, maximum and minimum auxiliary loads. The results of each case are plotted onto a distribution system graph, and the bus voltages are noted in "per unit" terms. The first case to be run (Case 1) assumed steady-state operation with a LOCA load. The source voltage was lowered until the low limit on the 480V MCC (.885 pu) was reached. The results of this case are shown on Figure 3. The 15 & 16 4 KV bus voltage was 3,897 volts (.936 pu). This is defined as the degraded voltage limit for the distribution system. Using the assumed ± 18 volt setting tolerance, a relay setpoint of 3915 volts (3897 + 18) was derived. To assure relay reset in subsequent analysis, the +18 volt positive side tolerance and the 42 volt reset band were added on, resulting in a 4 KV bus voltage of 3,975 volt (.955 pu). Thus, any transient case which results in a voltage recovery to 3975 volt or above in less than 10 seconds will assure that the degraded voltage protection scheme will not be actuated.

For ECCS actuation, two cases were run for each of the 4 KV sources. Case 2 is the transient case with LOCA load, 4 RHR pumps running and the two core spray pumps starting (the largest ECCS pumps). Case 3 is the steady-state condition after all ECCS loads are running. Table 7 tabulates the results of these cases and references the appropriate graph. The transient voltage never drops below 0.80 pu on any of the essential buses, a value which will start and accelerate the motors.

By design, the ECCS actuation signal initiates a shed of some major loads, therefore, the LOCA auxiliary load is less than the normal 100% load. Since the 4 KV bus voltages vary with auxiliary load, it is evident that minimum voltages must be established for the 115 KV line, the generator terminal and the 15 & 16 4 KV buses to assure that a manual start of a large ECCS pump at 100% power will not initiate the degraded voltage transfer scheme. Cases 4 & 5 were developed to address this concern. Case 4 assumes 100% load, steady-state conditions prior to a pump start. This case establishes the minimum voltages for the source and the 15 and 16 4 KV buses. Case 5 represents the steady-state conditions following a start of the core spray pump and demonstrates that the degraded voltage relays will reset following the start of the pump. The results of these cases are listed in Table 7.

To address the concern of over-voltage, the minimum plant steady-state auxiliary load was modeled in Case 6 and the source voltages (generator, 1R, 1AR) were increased until the upper limit on the MCC was reached. The results of this case are included in Table 7.

One final case, Case 7, verified that the generator and 1R source voltages for the condition of 100% load with the full compliment of torus cooling pumps (4 RHR pumps and 4 RHR service water pumps) would fall within the range established by the previous cases. The results of this case are listed in Table 7 as well.

3.3 Evaluation of Results

The operating ranges derived by the above analysis technique are summarized as follows:

Source	Min.	Max.
15 & 16 4 KV Buses	3989	4375
345 KV Grid	340	362
115 KV Grid	117.5	122
Generator Terminal Volts	21.3	22.5

Since August, 1983, procedures and controls including corrective actions were implemented to maintain the 345 KV and 115 KV grids within pre-established operating ranges. A review of the historic values of the switchyard voltages since August, 1983 indicates that the system can be maintained within the ranges listed above.

4. Confirmation of Voltage Analysis Through Testing

A confirmatory test will be performed to verify the analytical techniques and assumptions used in the voltage analysis. The test will be performed with No. 1R Reserve Transformer supplying the station auxiliary distribution system and:

a) loading the station distribution buses, including all Class 1E buses down to the 120/208V level, to at least 30%.
b) recording the voltages at steady state and during the starting of both a large Class 1E and non-Class 1E motor (not concurrently) on the string of buses which previously showed the lowest analyzed voltages.
c) comparing the analytically derived voltage values against the test results.

With good correlation between the analytical results and the test results the validity of the mathematical model used in the performance of the analysis will have been established. The test results should not be more than 3% lower than the analytical results.

5. Review of Design of Degraded Voltage Protection Logic

A review of the degraded voltage protection logic concluded that changes are warranted in the transfer scheme. The changes to the degraded voltage logic would involve transferring essential safeguard buses No. 15 & 16 to the preferred off-site standby reserve transformer if it has acceptable no load voltage. The absence of acceptable voltage would result in completion of the transfer to the emergency diesel generators.

Changes will be made to reduce the number of initiation signals to the diesels. These changes would result in the automatic start of the diesels for only:

- Degraded and/or loss of voltage on either of the essential 4 KV buses.
- Reactor water low low level or containment high pressure (ECCS actuation).

These changes will reduce the number of start challenges and subsequent no-load running time on the diesels. During light or no load operation (less than 20% load), the turbocharger is driven by the spring drive gear, rather than high energy exhaust gases. Extensive light or no load operation could cause wear in the turbocharger drive gear train. As a result, it is recommended that the turbocharger be inspected after approximately 200 hours of engine operation at less than 20% load. Based on experience we would expect no more than two hours per year of such operation.

These modifications to the degraded voltage protection logic and emergency diesel generator start logic will be implemented in accordance with the requirement of 10 CFR 50:59 during the 1984 refuel/maintenance outage.

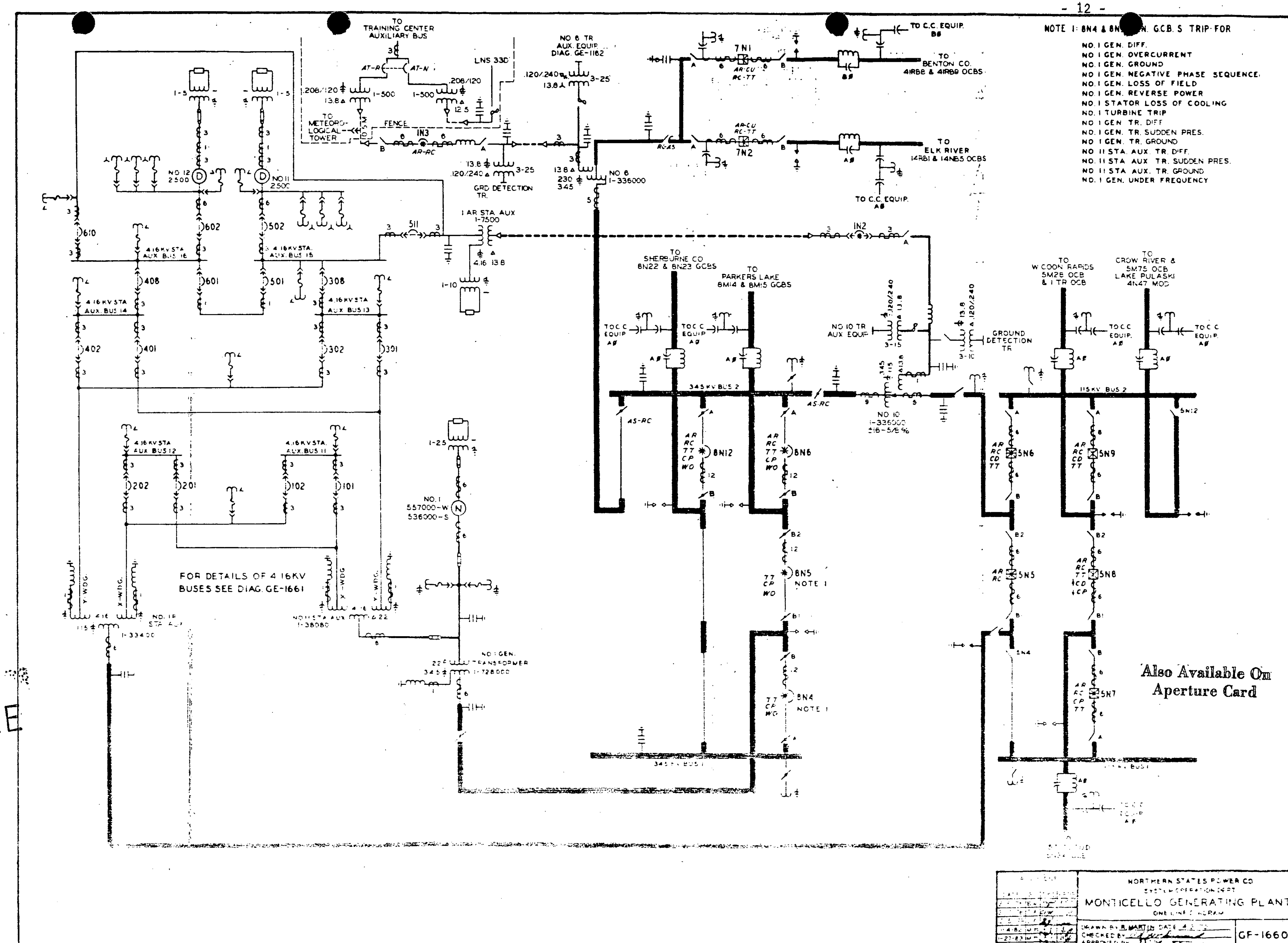
6. Modifications or Procedure Changes

The following changes and implementation dates are proposed as result of the re-analysis of the station auxiliary electrical distribution system:

	Modification	Implementation Date
1.	Instrument transformers tap change	1984 Outage
2.	Replacement of degraded voltage relays	1984 Outage
3.	Degraded voltage transfer scheme	1984 Outage
4.	Emergency diesel generator start logic	1984 Outage
5.	Procedural changes	1984 Outage

7. Technical Specifications

A change in the degraded voltage protection logic setpoint is desirable upon installation of the replacement degraded voltage relays. A proposed Technical Specification change will be submitted for NRC review within sixty (60) days of this submittal. The technical specification will be implemented upon completion of the design change for the replacement relays.



Also Available On Aperture Card

Figure 1

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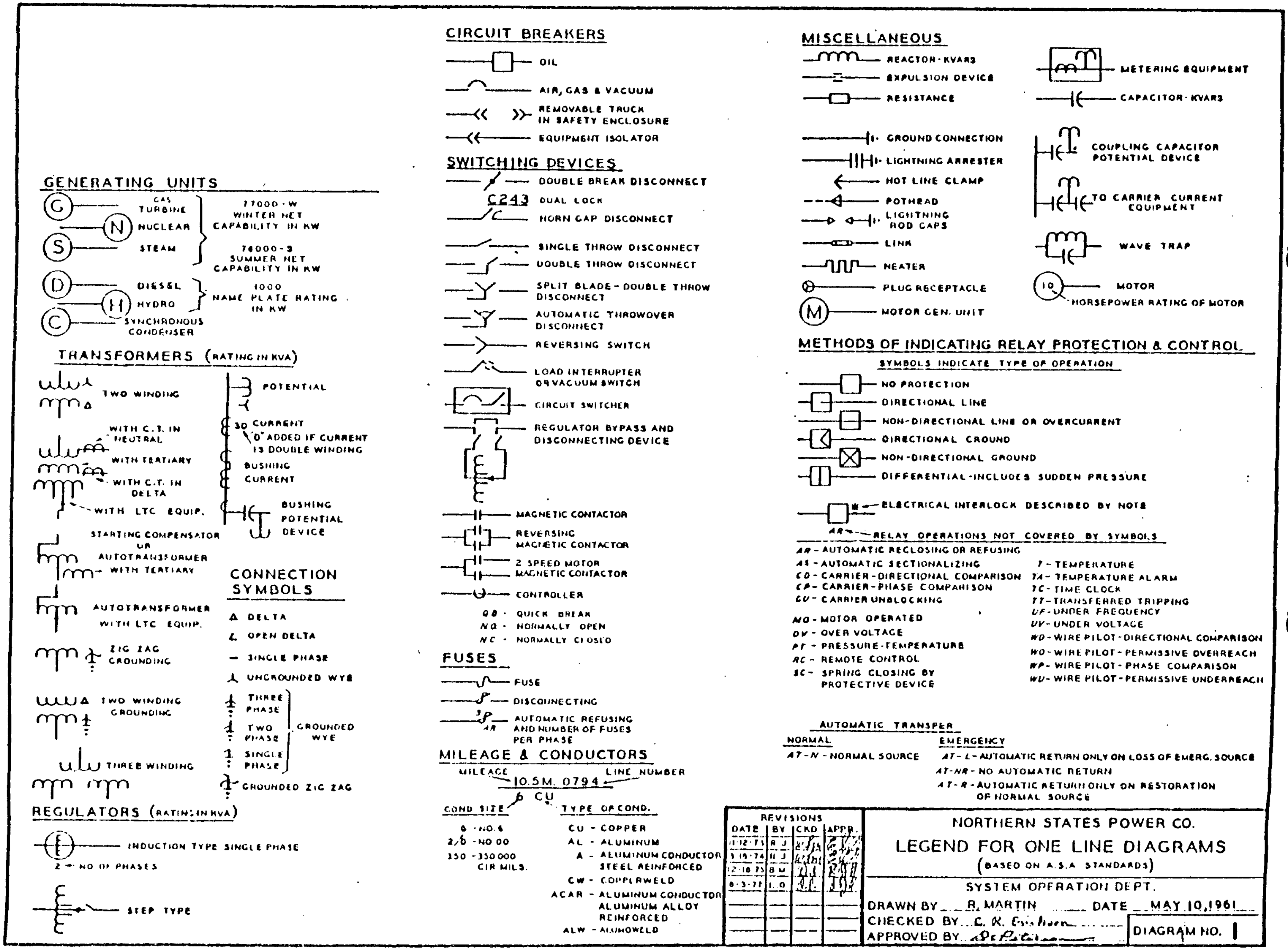
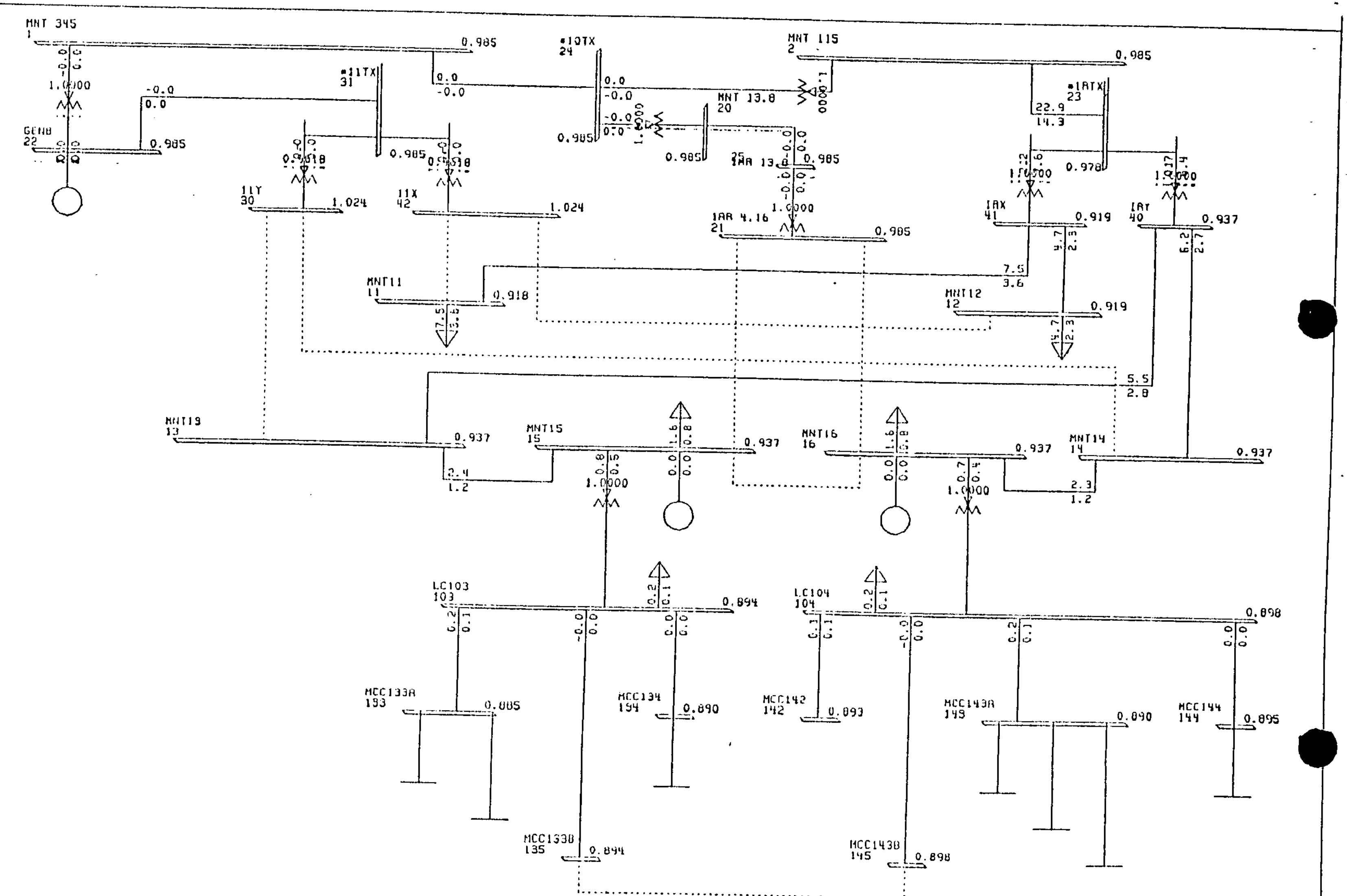
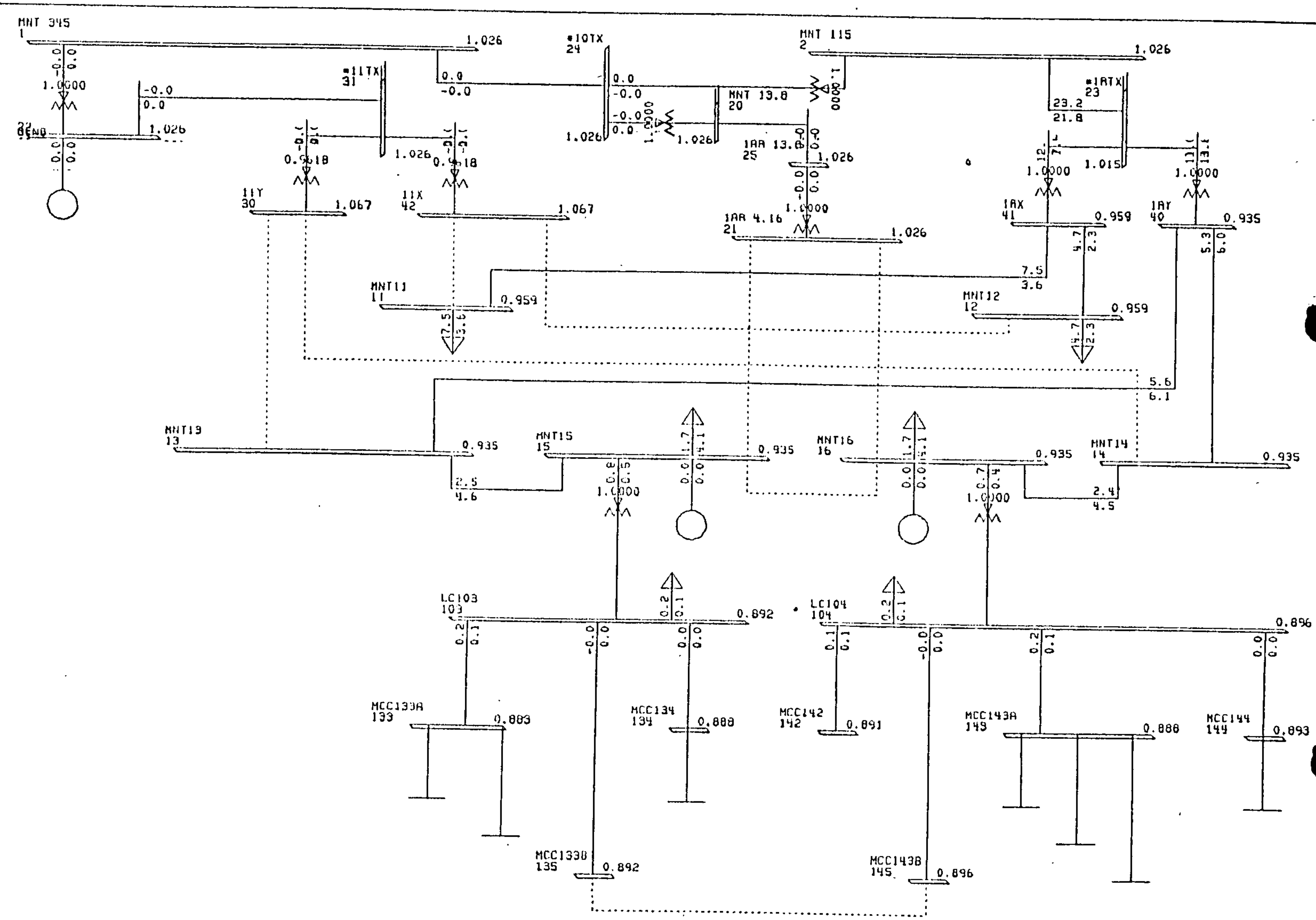
Figure 2 - One Line Diagram Legend





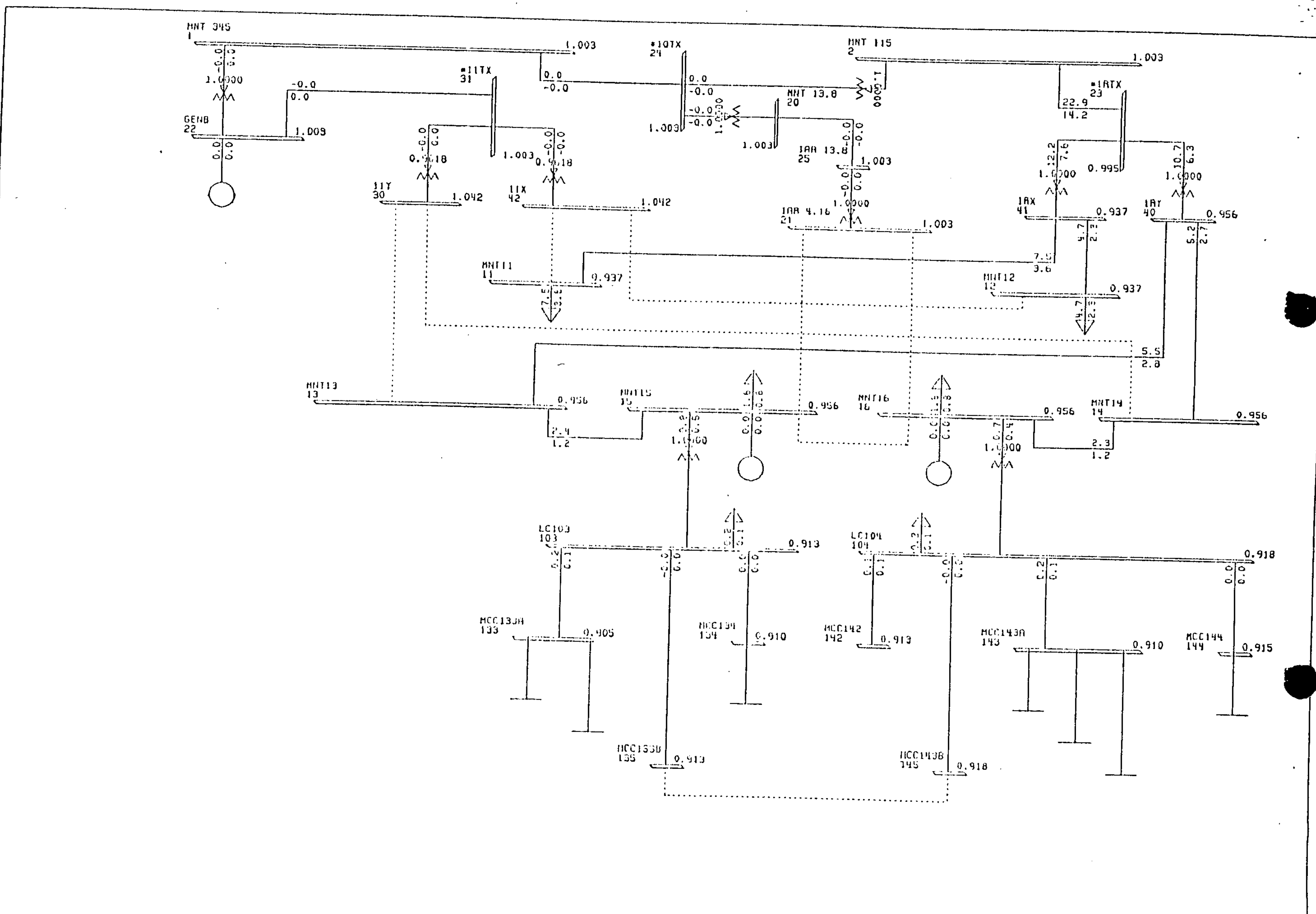
MNT AUX, TX 1R, TAP B, 113.3KV, M1R-LOCA.425
100%-C THR- 1 RECIRC+ 4 RHR+ 2 CORE SPRAY
MW & MVAR FLOW DIAGRAM THU, DEC 15 1983 10:25

Figure 3, Case 1



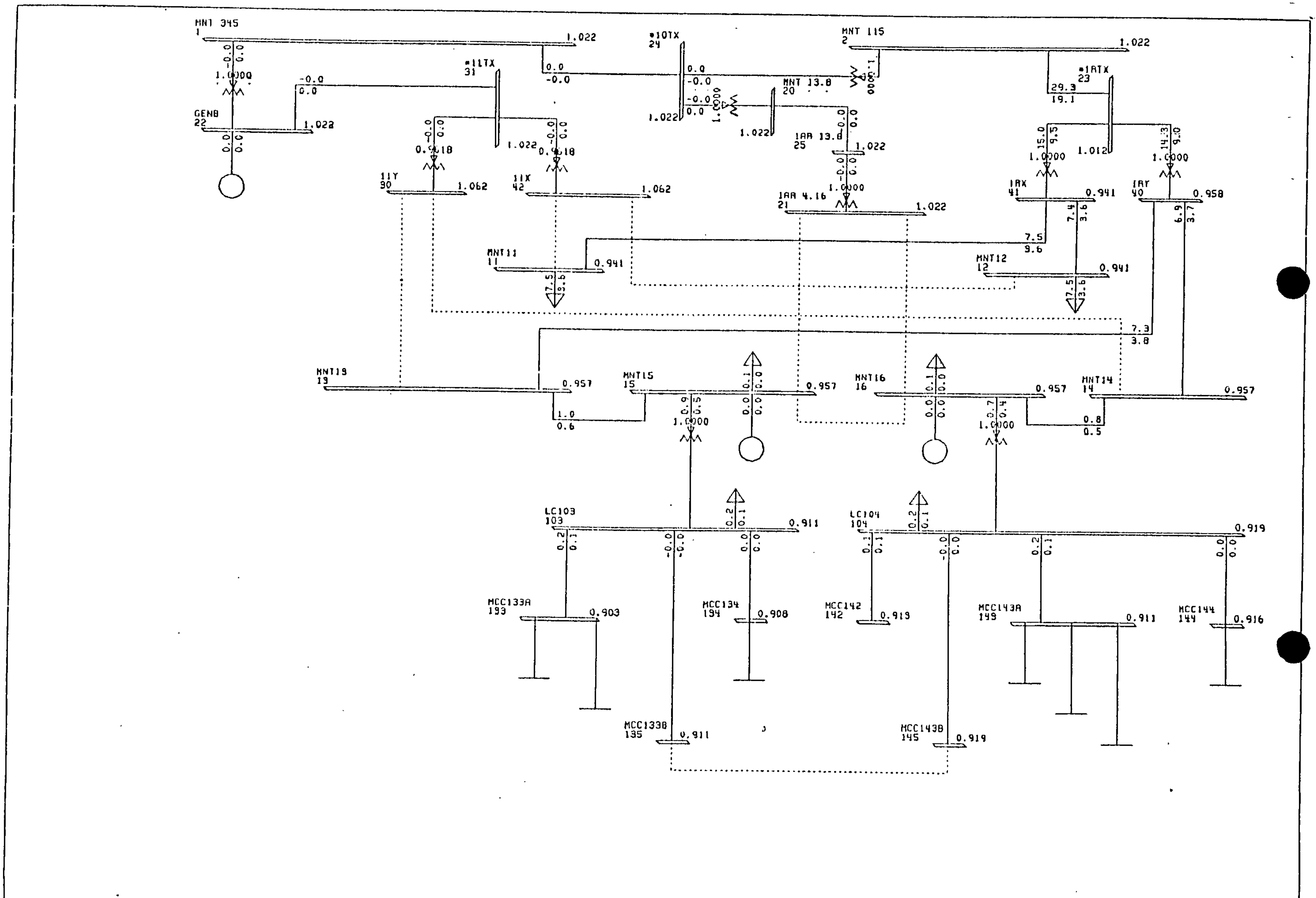
MNT AUX, TX 1R, TAP B, 115.3KV, M1R-S2CS
100%-C TWR- 1 RECIRC+4 RHR+STRT 2 CORE SPRAY
MW & MVAR FLOW DIAGRAM WED, DEC 14 1983 15:55

Figure 4, Case 2



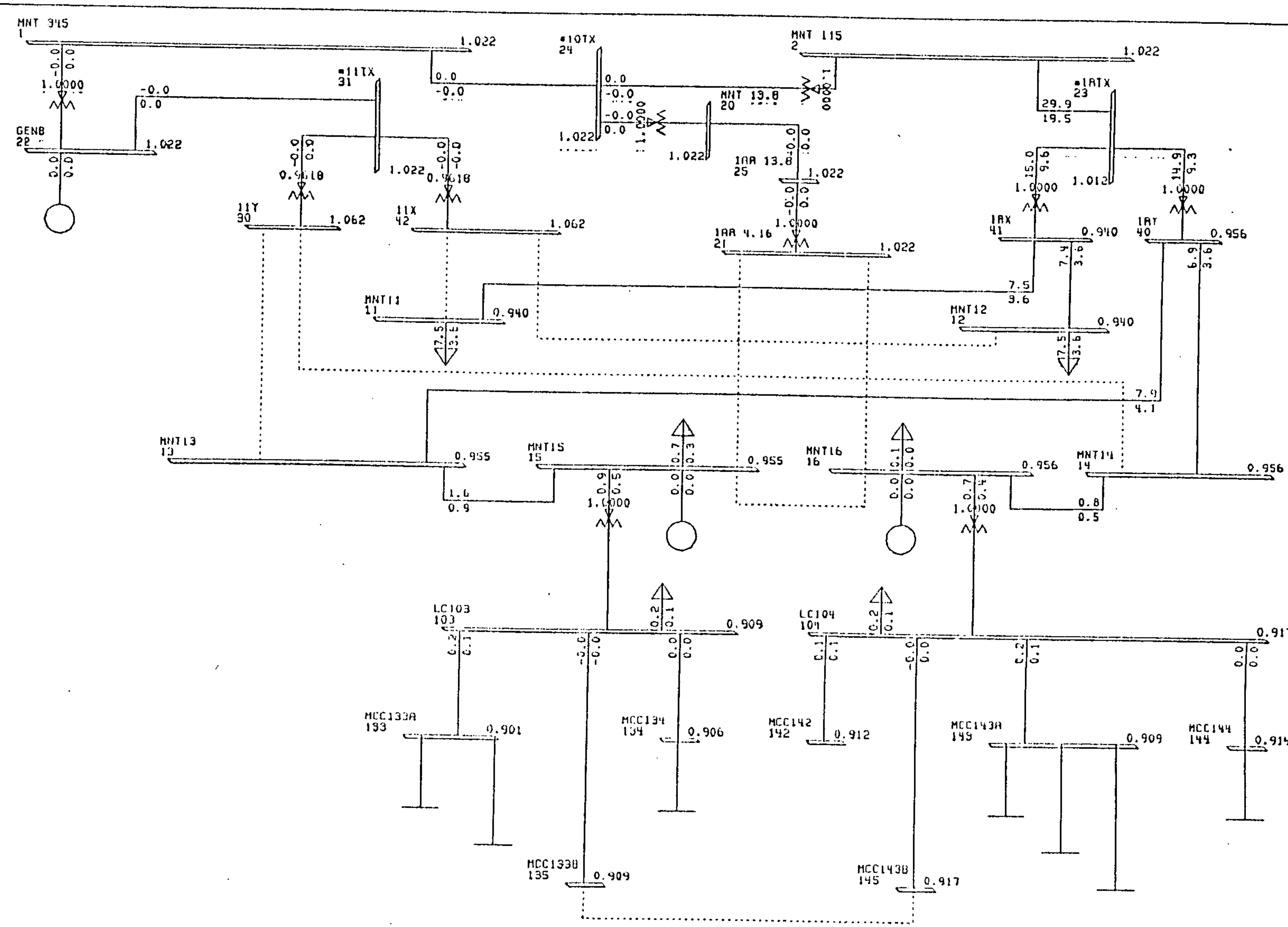
MNT AUX, TX 1R, TAP B, 115.3KV, M1R-LOCA
100%-C THR- 1 RECIRC+ 4 RHR+ 2 CORE SPRAY
MW & MVAR FLOW DIAGRAM   WED, DEC 14 1983   15:46

Figure 5, Case 3



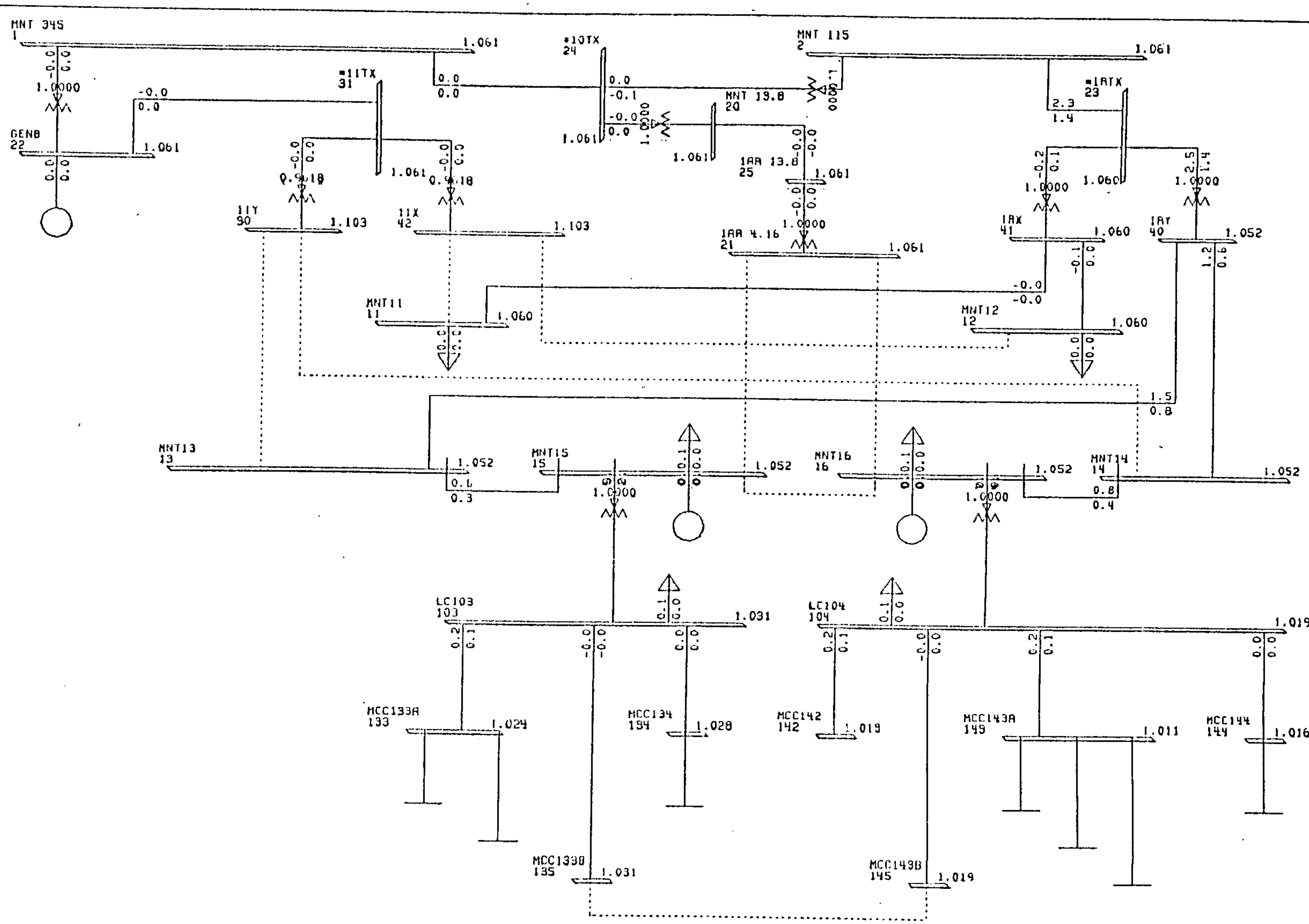
MNT AUX, TX 1R, TAP B, 117.5KV, M1R-SS
100% PLT (29.0MW) + PREPARED FOR I CORE SPRAY
MW & MVAR FLOW DIAGRAM WED, DEC 14 1983 16:13

Figure 6, Case 4



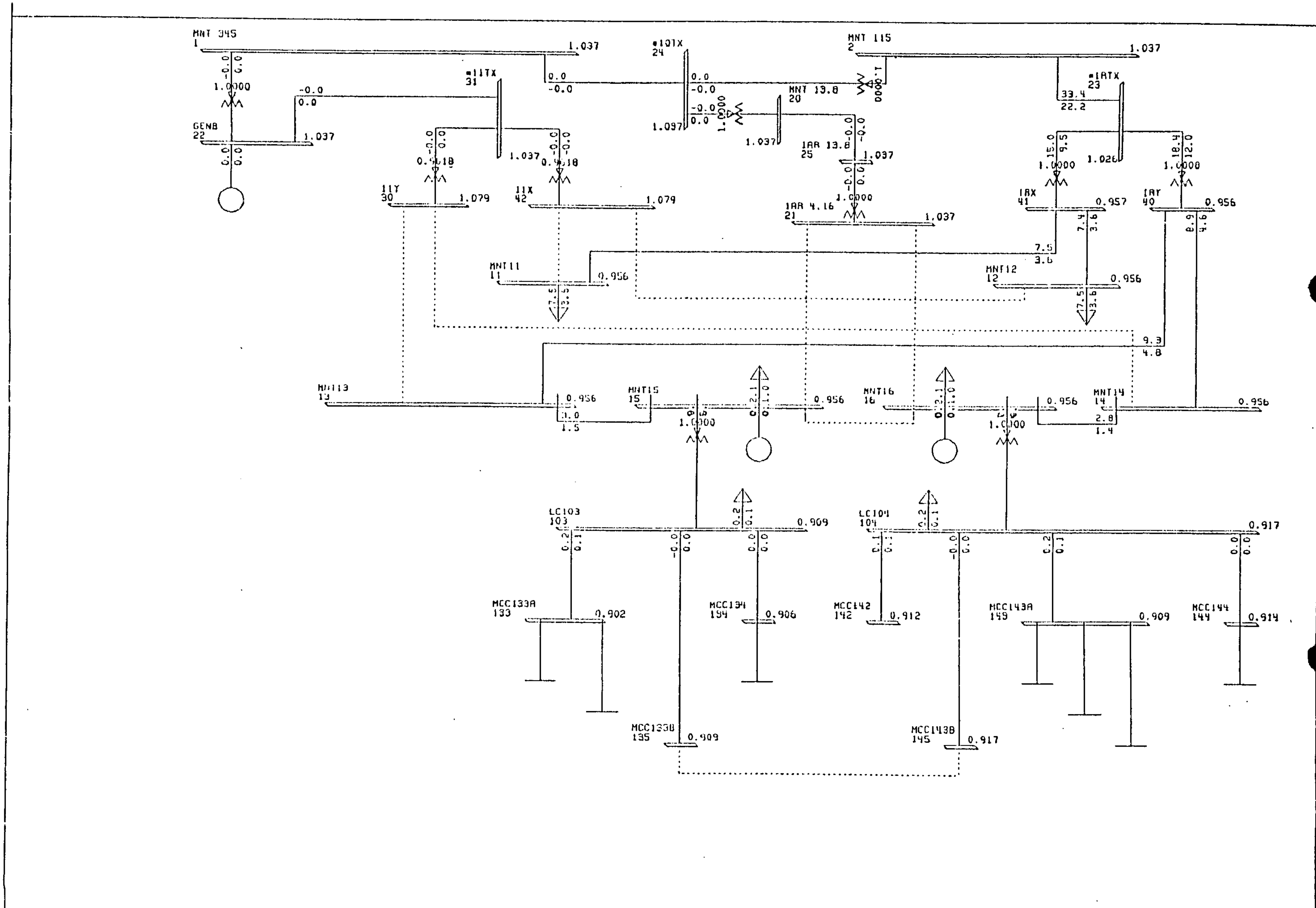
MNT AUX, TX 1R,TAP B,117.5KV, M1R-SSCS
100% PLT(29.0MW) PLUS 1 CORE SPRAY PUMP
MW & MVAR FLOW DIAGRAM WED, DEC 14 1983 15:59

Figure 7 , Case 5



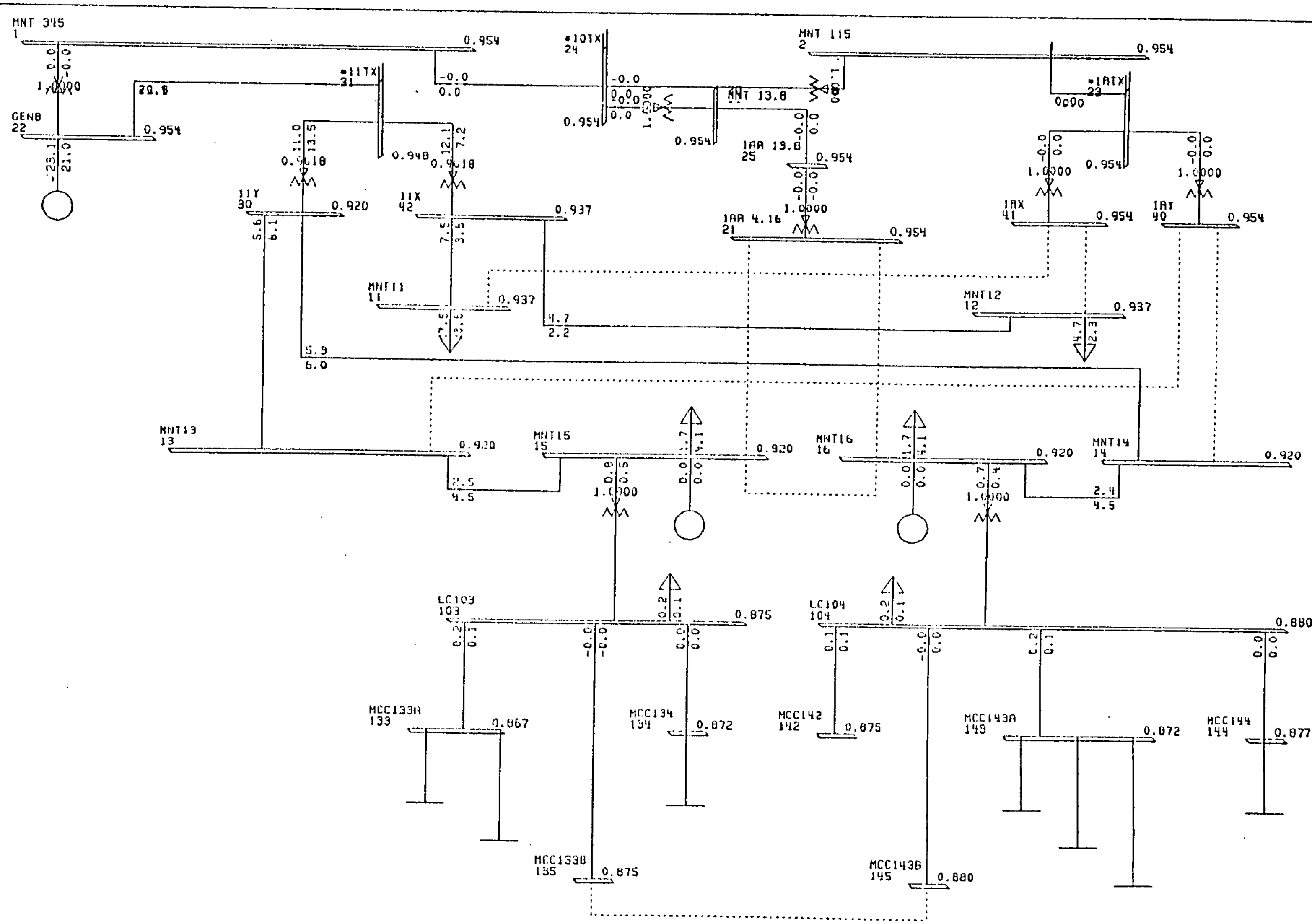
MNT AUX, TX 1R, TAP B, 122.0KV, M1R-MIN
MINIMUM PLT LOAD (2.7MW)
MW & MVAR FLOW DIAGRAM WED, DEC 14 1983 16:07

Figure 8 , Case 6



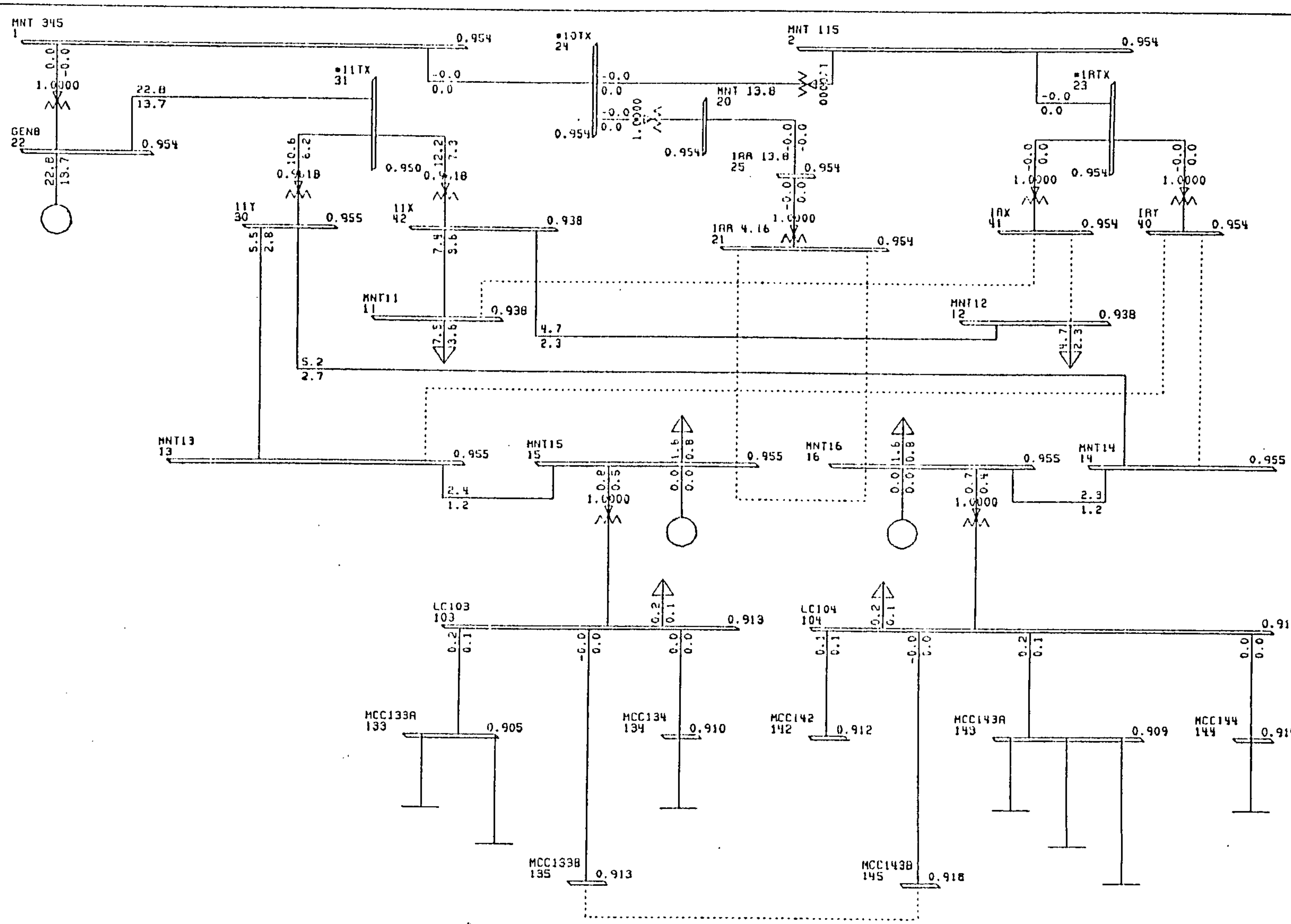
MNT AUX. TX 1B, TAP B.119.3KV, M1R-TORUS
100% PLT (29MW) +4 RHR +4 SRVC WTR PUMPS
MW & MVAR FLOW DIAGRAM WED, DEC 14 1983 16:08

Figure 9, Case 7

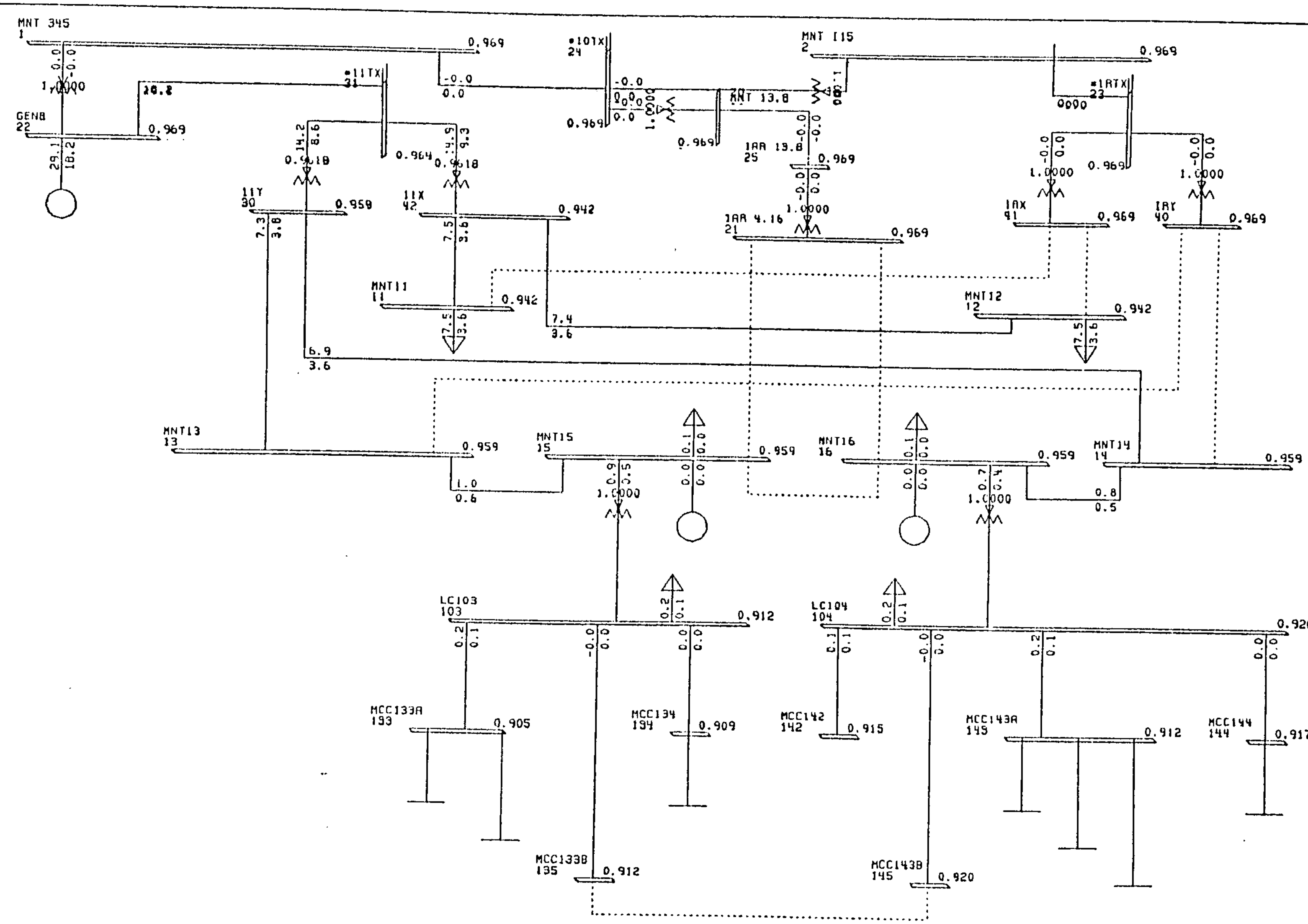


MNT AUX, TX 11,TAP 4,21.0KV, M11-S2CS
100%-C TWR-1 RECIRC+4 RHR+STRT 2 CORE SPRAY
MW & MVAR FLOW DIAGRAM WED, DEC 14 1983 16:05

Figure 10, Case 2

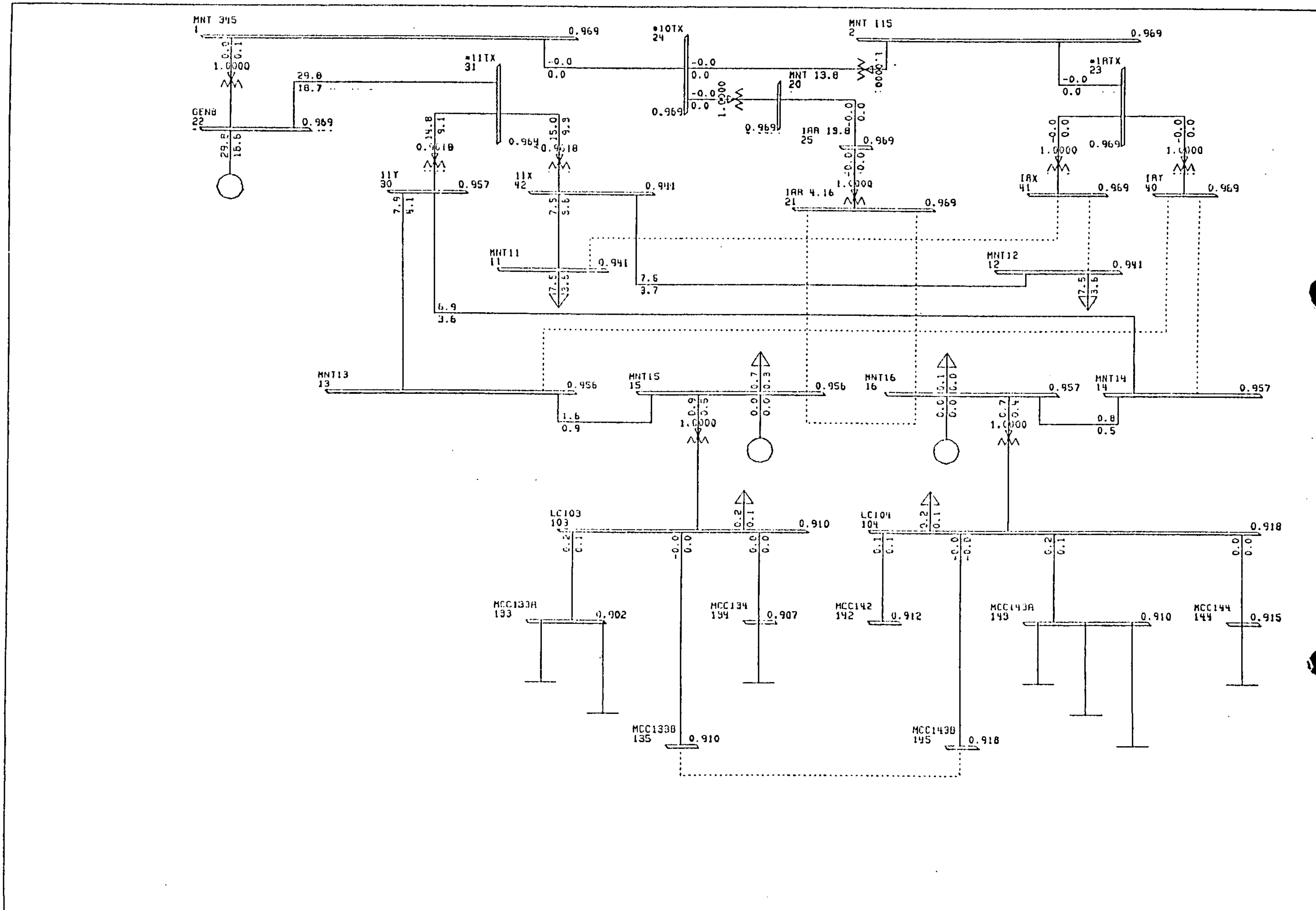


MNT AUX, TX 11, TAP 4, 21.0KV, M11-LOCA 100%-C TWR-1 RECIRC+4 RHR+ 2 CORE SPRAY MW & MVAR FLOW DIAGRAM THU, DEC 15 1983 10:30	Figure 11, Case 3



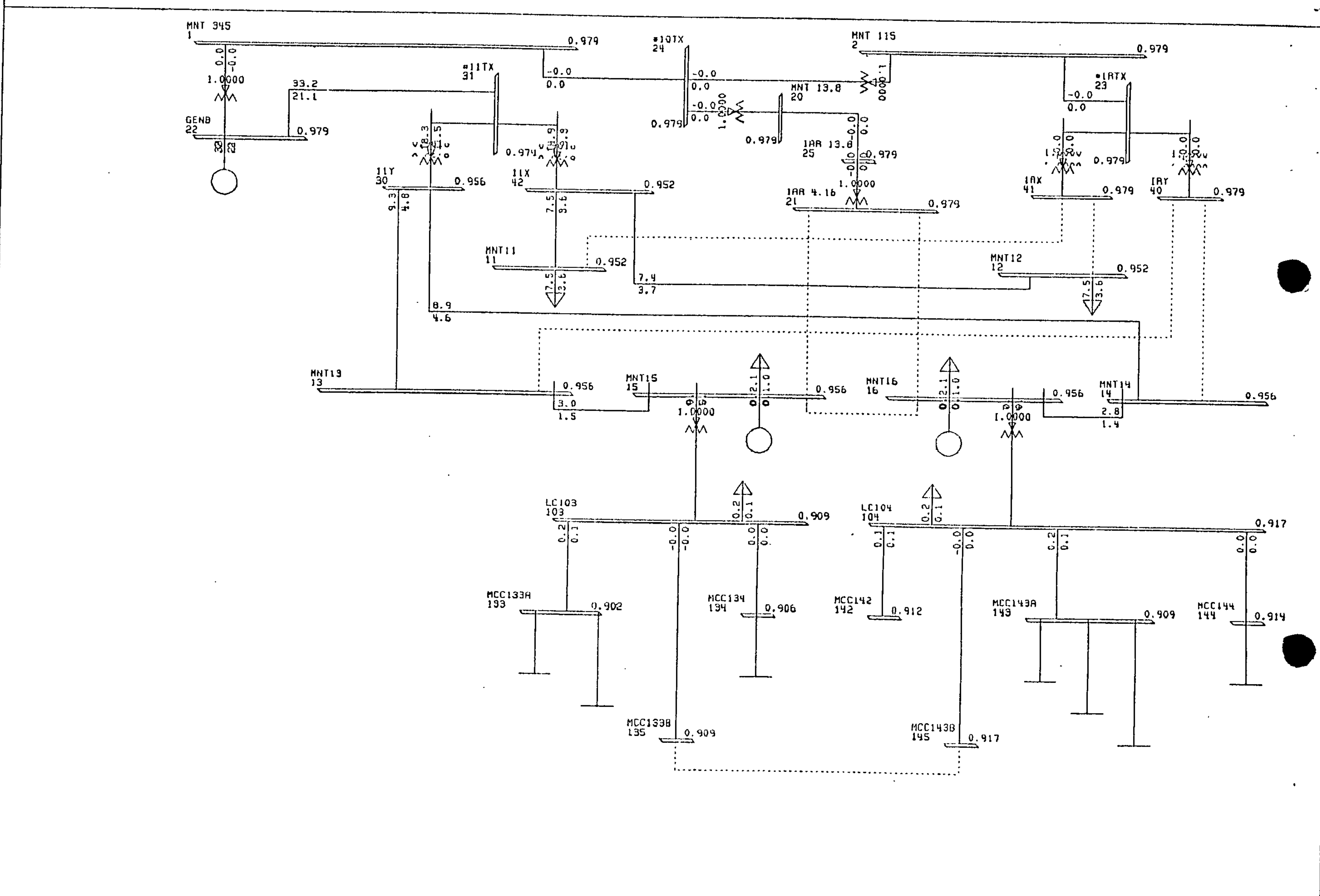
MNT AUX, TX 11, TAP 4, 21.3KV, M11-SS
100% PLT (29MW) + PREPARED FOR 1 CORE SPRAY
MW & MVAR FLOW DIAGRAM   WED, DEC 14 1983   16:15

Figure 12, Case 4



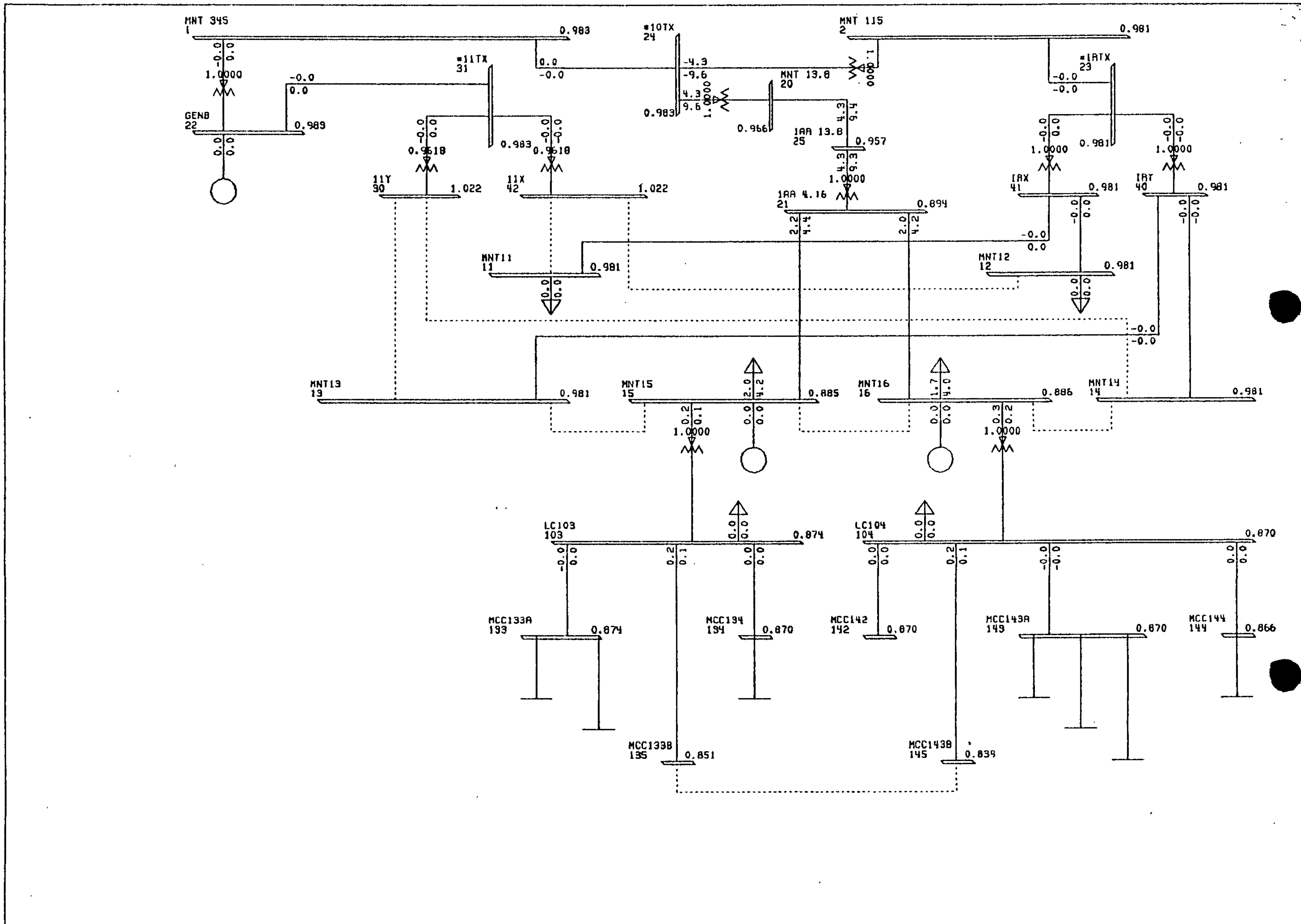
MNT AUX, TX 11,TAP 4.21.3KV, M11-SSCS
100% PLT(29.0MW) PLUS 1 CORE SPRAY PMP
MW & MVAR FLOW DIAGRAM WED, DEC 14 1983 16:06

Figure 13, Case 5



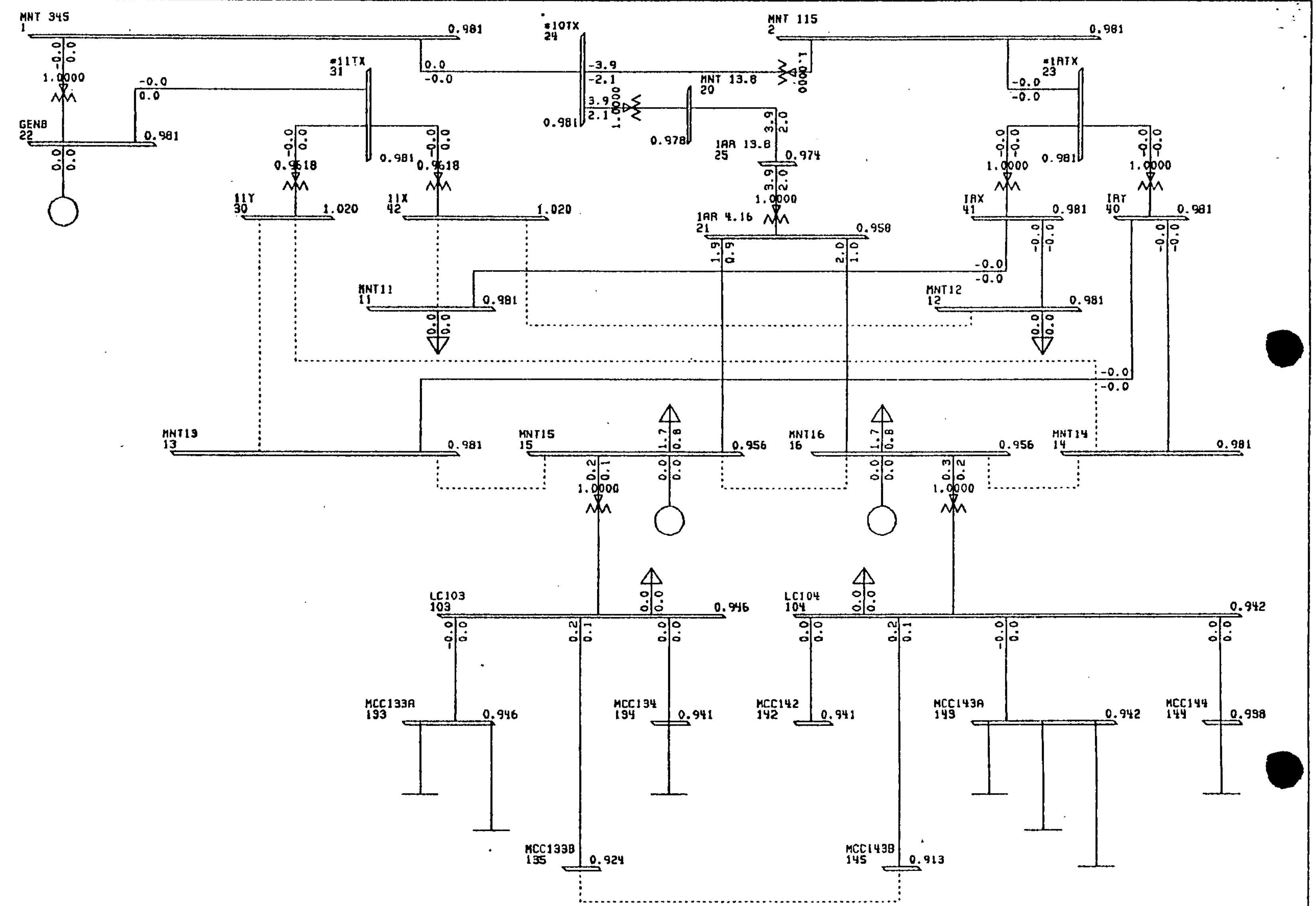
MNT AUX, TX 11, TAP 4, 21.55KV, M11-TORUS
100% PLT (29MW) + 4 RHR + 4 SRVC WTR PMP
MW & MVAR FLOW DIAGRAM THU, DEC 15 1983 10:20

Figure 14, Case 7



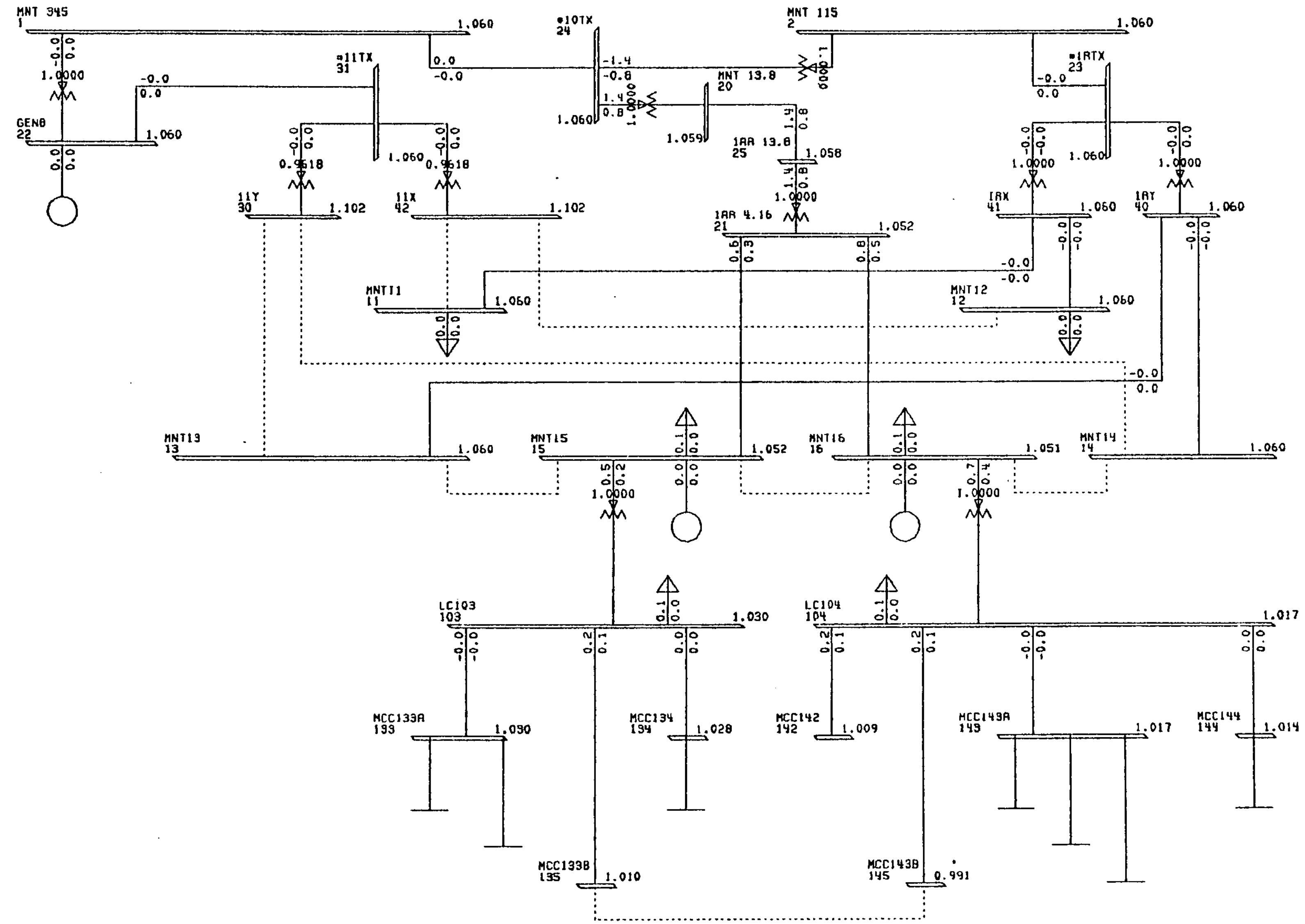
MNT AYX, TX 1AR,TAP 2,13.5KV, MIAR-52CS
STARTING 2 CORES SPRAY PMPS DURING LOCA
MW & MVAR FLOW DIAGRAM FRI, DEC 30 1983 09:07

Figure 15, Case 2



MNT AUX TX IAR TAP 2,13.5KV, M1AR-LOCA
3.8MW PLT LOAD, AFTER LOCA OCCURS
MW & MVAR FLOW DIAGRAM FRI, DEC 30 1983 09:05

Figure 16, Case 3



MNT AUX TX 1AR TAP 2,14.6KV, M1AR-MIN
MINIMUM LOAD (1.4MW) WITH MAXIMUM SOURCE VOLT
MW & MVAR FLOW DIAGRAM FRI, DEC 30 1983 09:09

Figure 17, Case 4

TABLE 1 - MONTICELLO NUCLEAR GENERATING PLANT TRANSFORMER RATINGS

Listed below is a summary of nameplate information for the main auxiliary and reserve transformers. The information is listed as follows: The first column identifies the transformer identification, followed by the KVA rating, primary voltage rating, taps voltage setting, secondary voltage rating, and impedance at the Volt-Ampere base.

Transformer Identification	KVA Rating	Primary Voltage	Taps Voltage	Secondary Voltage	Impedance % Z at VA Base X/R
Main Transformer #1	FOA 650,000 @ 55°C FOA 728,000 @ 65°C	345 KV Gnd Y 199.2KV Delta	370,875 (1) 362,250 (2) 353,625 (3) 345,000 (4)* 336,375 (5)	22KV	11.09 % @ 650,000 KVA
Station Aux. Transformer #11	OA 20,400 @ 55°C FA 27,200 @ 66°C FOA 34,000 @ 55°C Transformer Suitable for Operation @ 112% KVA Continuous @ 65°C	21,700	22,780 (1) 22,240 (2) 21,700 (3) 21,160 (4)* 20,620 (5)	4,160/ 2,400	14.61 % H-X 14.77 % H-Y 28.30 % X-Y 20,400 KVA Base
Reserve Station Aux. Transformer 1R	OA 20,000 @ 55°C OA 22,400 @ 65°C FA (1) 26,667 @ 65°C FA (1) 29,867 @ 55°C FA (2) 33,333 @ 55°C FA (2) 37,333 @ 65°C	115, KV Grounded Y	117,875 (A) 115,000 (B)* 112,125 (C) 109,255 (D) 106,376 (E)	4,160/ 2,400	7.8 % H-X 7.6 % H-Y 14.4 % X-Y at 10,000 KVA Base
Reserve Station Aux. Transformer 1 AR	OA 7500 @ 55°C	14,000 Delta	14,350 (A) 14,000 (B)* 13,650 (C) 13,300 (D)* 12,950 (E)	2,500 Delta 4,330 Y	4.6% 7,500 KVA base

Note: FOA = Forced Oil & Air
OA = Oil & Air
FA = Forced Air

* - Tap Setting at Time of Survey

TABLE 1A 480 V LOAD CENTER TRANSFORMERS

Listed below is a summary of nameplate information for load center transformers and load center load summaries. The nameplate information is listed as follows: The first column identifies the transformer followed by the KVA Rating, Primary Voltage Rating, Taps Voltage Setting, Secondary Voltage Rating, and Impedance at the Volt-Ampere Base.

Transformer Identification	KVA Rating	Primary Voltage	Taps Voltage	Secondary Voltage	Impedance % Z at VA Base X/R
Load Center Transformer 101 (X10) For Load Center 101 (B1)	QA 1,500 @ 65°C FA 1,700 @ 65°C	4,160 V	4,360 (1) 4,260 (2) 4,160 (3)* 4,055 (4) 3,950 (5)	480	11.26% at 1,500 KVA Base 4,160
Load Center Transformer 102 (X20) For Load Center 102 (B2)	QA 1,500 @ 65°C FA 1,725 @ 65°C	4,160 V	4,360 (1) 4,260 (2) 4,160 (3)* 4,055 (4) 3,950 (5)	480	11.43 % at 1,500 KVA Base
Load Center Transformer 103 (X30) For Load Center 103 (B3)	QA 1,500 @ 65°C FA 1,725 @ 65°C	4,160 V	4,360 (1) 3,460 (2) 4,160 (3)* 4,055 (4) 3,950 (5)	480	11.37% at 1,500 KVA Base
Load Center Transformer 104 (X40) For Load Center 104 (B4)	QA 1,500 @ 65°C FA 1,725 @ 65°C	4,160 V	4,360 (1) 4,260 (2) 4,160 (3)* 4,055 (4) 3,950 (5)	480/277	11.46 % at 1,500 KVA Base
Load Center Transformer 105 (X50) and 108 (X80) For Load Center 105 (B5)	QA 1,500 @ 65°C FA 1,725 @ 65°C	4,160 V	4,360 (1) 4,260 (2) 4,160 (3)* 4,055 (4) 3,950 (5)	480/277	8.34 % at 1,500 KVA Base
	QA 1,500 @ 65°C FA 1,725 @ 65°C	4,160 V	4,360 (1) 4,260 (2) 4,160 (3)* 4,055 (4) 3,950 (5)	480/277	8.34 % at 1,500 KVA Base

TABLE 1A 480 V LOAD CENTERS TRANSFORMERS (cont'd)

Transformer Identification	KVA Rating	Primary Voltage	Taps Voltage	Secondary Voltage	Impedance % Z at VA Base X/R
Load Center	QA 1,500 @ 65°C	4,160 V	4,360 (1)	480/277	8.36% at 1,500
Transformer 106 (X60)	FA 1,700 @ 65°C		4,260 (2)		KVA Base
and 107 (X70)			4,160 (3)*		
For Load Center 106 (B6)			4,055 (4)		
			3,950 (5)		
	QA 1,500 @ 65°C	4,160 V	4,360 (1)	480/277	8..36 % at 1,500
	FA 1,725 @ 65°C		4,260 (2)		KVA Base
			4,160 (3)*		
			4,055 (4)		
			3,950 (5)		
Load Center	QA 1,500 @ 150°C	4,160 V	4,360 (1)	480/277	10.78 % at 1,500
Transformer 109 (X90)	FA 2,000 @ 150°C		4,260 (2)		KVA Base
For Load Center 109 (B9)			4,160 (3)*		
			4,055 (4)		
			3,950 (5)		

* - Tap Setting at Time of Survey.

TABLE 2

4160V Bus Electrical Equipment Listing

Electrical Bus Loads		
Bus #11 4160V	1 - Reactor Feed Pump	6000 HP
	1 - Recirc. Pump MG Set	4000 HP
Bus #12 4160V	1 - Reactor Feed Pump	6000 HP
	1 - Recirc. Pump MG Set	4000 HP
Electrical Bus Loads		
Bus #13 4160V	1 - Circulating Water Pump	1250 HP
	1 - Condensate Pump	1750 HP
	1 - Cooling Tower Feeder	4300 HP
	1 - 480V L.C. #101	1725 KVA
	1 - Switchyard L.C.	
	1 - Feeder Bus #15	
	1 - 480V L.C. #109	1500 KVA
Bus #14 4160V	1 - Circulating Water Pump	1250 HP
	1 - Condensate Pump	1750 HP
	1 - Cooling Tower Feeder	4300 HP
	1 - 480V L.C. #102	1725 KVA
	1 - Switchyard L.C.	
	1 - Feeder Bus #16	
Bus #15 4160V	1 - Core Spray Pump	800 HP
	2 - RHR Pumps	600 HP
	2 - RHR Service Water Pumps	700 HP
	1 - CRD Pump	250 HP
	1 - Turbine Auxiliary Oil Pump	250 HP
	1 - 480V L.C. #103	1500 KVA
	1 - Bus Tie	
Bus #16 4160 V	1 - Core Spray Pump	800 HP
	2 - RHR Pumps	600 HP
	2 - RHR Service Water Pumps	700 HP
	1 - CRD Feed Pump	250 HP
	1 - 480V L.C. #104	
	1 - Bus Tie	
Bus #17 4160V	1 - Cooling Tower Pump	2500 HP
Bus #18 4160V	1 - Cooling Tower Pump	2500 HP

TABLE 3 MONTICELLO NUCLEAR GENERATING PLANT LOAD CHARACTERISTICS

Bus	Load Description
11	Non-Essential
12	Non-Essential
13	Non-Essential
14	Non-Essential
15	RHR Service Water Pump (2/bus)
	CRD Pump
	Core Spray Pump
	RHR Pump (2/bus)
	Turbine Aux Oil Pump
	480 V Load Center 103
16	RHR Service Water Pump (2/bus)
	CRD Pump
	Core Spray Pump
	RHR Pump (2/bus)
	480V Load Center 104
480V Load Center 103	MCC B31 MCC B32 MCC B33A* & B33B* Service Water Pump
480V Load Center 104	MCC B41 MCC B42B MCC B43A*, B43B*, & B42A* Service Water Pump Fire Pump

* Essential Motor Control Centers

Essential 120 VAC panels supplied via 480 VAC Step-Down Transformers
- See Table 4

TABLE 4 IMPEDANCE DATA

FROM	TO	LINE R	LINE X
345 Kv	Generator	0.0001	0.0018
345 Kv	No. 10 Transformer	0.0008	0.1019
115 Kv	No. 1R Transformer	0.0020	0.0500
115 Kv	No. 10 Transformer	0.0006	-0.0203
Bus No. 11	No. 1R XFMR X-Winding	0.0012	0.0029
Bus No. 11	No. 11 XFMR X-Winding	0.0008	0.0018
Bus No. 12	No. 1R XFMR X-Winding	0.0001	0.0004
Bus No. 12	No. 11 XFMR X-Winding	0.0001	0.0004
Bus No. 13	Bus No. 15	0.0002	0.0020
Bus No. 13	Bus No. 17	0.1435	0.1940
Bus No. 13	No. 11 XFMR Y-Winding	0.0008	0.0018
Bus No. 13	No. 1R XFMR Y-Winding	0.0012	0.0029
Bus No. 13	Load Center 101	0.8781	7.4670
Bus No. 13	Load Center 105	0.8803	5.6996
Bus No. 13	Load Center 109	0.8781	7.1370
Bus No. 14	Bus No. 16	0.0002	0.0020
Bus No. 14	Bus No. 18	0.1435	0.1940
Bus No. 14	No. 11 XFMR Y-Winding	0.0001	0.0004
Bus No. 14	No. 1R XFMR Y-Winding	0.0001	0.0004
Bus No. 14	Load Center 102	0.8787	7.5769
Bus No. 14	Load Center 106	0.8163	5.6727
Bus No. 15	Bus No. 16	0.0002	0.0020
Bus No. 15	No. 1AR Transformer	0.0168	0.1714
Bus No. 15	Load Center 103	0.8787	7.5378
Bus No. 16	No. 1AR Transformer	0.0168	0.1714
Bus No. 16	Load Center 104	0.8787	7.5980
No. 10 XFMR Tertiary	No. 10 Transformer	-0.0002	0.1759
No. 10 XFMR Tertiary	No. 1AR Transformer	0.0584	0.0598
No. 1AR XFMR Low Side	No. 1AR XFMR High Side	0.0932	0.6076
Generator	No. 11 Transformer	0.0013	0.0255
No. 1R Transformer	No. 1R XFMR Y Winding	0.0557	0.5525
No. 1R Transformer	No. 1R XFMR X Winding	0.0400	0.7554
No. 11 XFMR Y Winding	No. 11 Transformer	0.0459	0.4496
No. 11 Transformer	No. 11 XFMR X Winding	0.0351	0.6490
Load Center 101	MCC 111	2.1563	2.9141
Load Center 101	MCC 113	1.6172	2.1856
Load Center 101	MCC 115	6.3000	8.5440
Load Center 101	MCC 116	1.8000	2.4330
Load Center 102	MCC 121	0.7307	0.9875
Load Center 102	MCC 122	2.9768	4.0230
Load Center 102	MCC 124	6.3000	8.5440
Load Center 102	MCC 125	1.8000	2.4330
Load Center 103	MCC 131	0.9523	1.2870
Load Center 103	MCC 132	2.5815	3.4887
Load Center 103	MCC 133A	2.2281	3.0112

TABLE 4 (Cont'd)

FROM	TO	LINE R	LINE X
Load Center 103	MCC 133B	7.2170	7.9696
Load Center 103	MCC 134	9.2515	6.7719
Load Center 104	MCC 141	2.3599	3.1893
Load Center 104	MCC 142	2.0784	2.8083
Load Center 104	MCC 143A	2.0065	2.7117
Load Center 104	MCC 143B	7.2170	7.9696
Load Center 104	MCC 144	6.7625	4.9500
Load Center 109	MCC 112	2.4198	3.2702
Load Center 109	MCC 114	5.1032	6.8966
Load Center 109	MCC 123	4.2286	5.7148
Load Center 109	MCC 191	9.6080	10.2610
Load Center 109	MCC 192	9.6080	10.2160
Load Center 109	MCC 193	9.6080	10.2160
MCC 133B	MCC 143B	2.0000	2.0000

TAB[illegible]5 120V INSTRUMENT TRANSFORME[illegible]

Listed below is a summary of nameplate information for instrument transformers. The nameplate information is listed as follows: The first column identifies the transformer, followed by the KVA Rating, Primary Voltage Rating, Taps Voltage Setting and Secondary Voltage Rating.

TRANSFORMER IDENTIFICATION	KVA RATING	PRIMARY VOLTAGE	TAPS VOLTAGE	SECONDARY VOLTAGE
Standby Instrument Transformer No. 11 Transformer Source - MCC133	37.5	480	504 492 480* 468 456 444 432	120/240 Single Phase
Instrument Transformer No. 12 For Panel Y20 & Y30 Transformer Source - MCC133	25.0	480	504 492 480* 468 456	120/240 Single Phase
Instrument Transformer No. 16 For Panel Y10 Transformer Source UPS Sys.	25.0	120	120	120/240 Single Phase
Instrument Transformer No. XB34P For Panel B34P-EFT Transformer Source EFT MCC134	15.0	480	504 492 480* 468 456	120/240 Single Phase
Instrument Transformer No. XB44P For Panel B44P-EFT Transformer Source EFT MCC 144	15.0	480	504 492 480* 468 456	120/240 Single Phase
CAM Tranformer A For Panel P72A Transformer Source MCC133	20.0	480	504 492 480 468* 456	208Y/120 Three Phase
CAM Transformer B For Panel P72B Transformer Source - MCC143	15.0	480	504 492 480 468* 456	208Y/120 Three Phase
Emergency Lighting Transf. No. XL-04 For Panel L-34 Transformer Source MCC 143	15.0	480	504 492 480* 468 456	208Y/120 Three Phase
Emergency Lighting Transf. No. XL-10 For Panel L-38 Transformer Source MCC 133	15.0	480	504 492 480* 468 456	208Y/120 Three Phase
Emergency Lighting Transf. No. XL-12 For Panel L-44 Transformer Source MCC 133	15.0	480	504 492 480* 468 456	208Y/120 Three Phase

* Tap Setting at Time of Survey

TABLE 6 MONTICELLO NUCLEAR GENERATING PLANT LOAD REJECTION AND VOLTAGE RESTORATION LOGIC SETTINGS

Function	Setting (nominal and tolerance)
Loss of Voltage Detection on Bus 15 or 16	2625 ± 175 V with no intentional time delay
Degraded Voltage Detection on Bus 15 or 16	3885 ± 18 V with 10 ± 1 sec time delay
Time Delay for Transfer to 1R	No intentional time delay
Time Delay for Transfer to 1AR	5 ± 1 sec.
Time Delay for Transfer to Diesel Generators	10 ± 1 sec on loss of voltage 5 ± 1 sec on degraded voltage

TABLE 7

SUMMARY OF VOLTAGE ANALYSIS RESULTS

Case #	Figure #	Source	Source Volt (KV)	15 Bus Volt	16 Bus Volt	133 MCC Volt	143 MCC Volt	Case Description
1	3	1R	113.3	3897	3898	425	427	LOCA Load, Min. MCC Volts
2	4	1R	115.3	3889	3890	424	426	LOCA, 2 Core Spray Pumps Starting
3	5	1R	115.3	3975	3976	435	437	LOCA, Steady-State
4	6	1R	117.5	3982	3983	434	437	100% Load
5	7	1R	117.5	3975	3976	433	436	100% Load, Core Spray Pump Running
6	8	1R	122	4375	4375	492	485	Min. Load, Max. Source
7	9	1R	119.3	3977	3978	433	436	100% Load Plus Torus Cooling
2	10	GEN	21.0	3825	3826	416	418	LOCA, 2 Core Spray Pumps Starting
3	11	GEN	21.0	3975	3975	435	437	LOCA, Steady-State
4	12	GEN	21.3	3988	3989	434	438	100% Load
5	13	GEN	21.3	3979	3979	433	437	100% Load, Core Spray Pump Running
6	None	GEN	22.5	4375	4375	492	485	Min. Load, Max. Source
7	14	GEN	21.55	3976	3977	433	436	100% Load, Plus Torus Cooling
2	15	1AR	13.3	3683	3684	420	418	LOCA, 2 Core Spray Pumps Starting
3	16	1AR	13.5	3977	3977	454	452	LOCA, Steady-State
4	17	1AR	14.6	4375	4373	495	488	Min. Load, Max. Source