(Slide.)

This is one division of RHR complex.

MR. KERR: Other questions?

(No response.)

Thank you, sir.

Mr. McKelvey.

MR. McKELVEY: My name is Terry McKelvey. I am the principal electrical engineer involved in the design of Fermi 2. And I am going to present to you the reliability of our station power, including the effects of the loss of various stages of AC and DC, and get into the discussion on station blackout.

In order to do that, I would like to give you a feeling for the diversity of our offsite power source.

(Slide.)

Also for its independence and how we derive it from our electrical transmission system. First of all, the offsite power source at Fermi 2 is made up of five separate transmission lines, two from our 345-kV system and three separate lines on the 120-kV.

As you can see here, the 120-kV lines are from three separate s :ions on our system.

MR. CARBON: Could you step back and use the pointer, please.

MR. McKELVEY: Okay.

As you can see, the three 120-kV lines originate at three separate locations in our 120-kV transmission system. The 345-kV lines, transmission lines coming to Fermi 2, are both from our Brownstown station, which actually is a split station. It is treated as if it was two separate stations. They come into two separate switch areas located on the Fermi site.

The existing 120-kV switchyard was for the Fermi 1 plant. It has been in existence for approximately 14 years. The 345-kV switchyard is for the transmission of power offsite from Unit 2.

As you can see here, we have a tie to Consumers Power in the area. It has the Whiting power plant. It is approximately 20 miles from the Fermi site. In addition, we are tied to Consumers Power in nine different locations. We are also tied to Ontario Hydro and Toledo Edison. The combined total of our ties to neighboring facilities is 7300 megawatts capacity.

MR. RAY: Those other locations are from other points on the system?

MR. McKELVEY: Yes, there are nine separate points there where we tie to Consumers. For example, two separate Ontario Hydro and three separate transmission lines to Toledo Edison.

MR. RAY: Are any of these ties to other pools at

345-kV?

MR. McKELVEY: Yes, they are. The ties to Toledo Edison are at 345, and also to Ontario Hydro.

MR. CARBON: How widely separated are the five lines coming into the plant?

MR. McKELVEY: Okay. There is a common transmission corridor into Fermi 2 for approximately five miles. That is as shown here (Indicating). The line -- the corridor is 500 feet wide. It has been designed to take the worst failure of any structure falling over that would leave enough lines -- all we need out of these five lines is one separate line existing to power adequate ESF at Fermi 2.

So we have designed the spacing of the transmission lines on this common corridor to accommodate the falling over of a 345-kV tower.

MR. CARBON: Each of the lines has its own --

MR. McKELVEY: Support of tower, right.

MR. RAY: When you say they are designed -- the falling tower will not impact an adjacent line?

MR. McKELVEY: There are five separate lines. The 345-kV towers are on the outside of the 500-foot right of way. In the center are the three 120kV lines. Obviously, the largest structure is the 345-kV tower and if one of those lines fell over across the other transmission lines we would still have adequate transmission lines available to

shut the plant down.

MR. RAY: You have not answered the question, but you have given me an implied answer. I gather from what you say that if the EHF line went down it would take down one of the 120-kV lines, is that what you are saying?

MR. McKELVEY: Yes, it would.

MR. RAY: So you would have three left.

MR. McKELVEY: It might take a couple lines down. We would have at least one transmission line available to the site.

MR. RAY: All five lines are on the same right of way?

MR. McKELVEY: that is right.

MR. RAY: The two large ones are on the outside. So between the two large ones there are three others.

MR. McKELVEY: Right.

MR. RAY: Are you saying, then, that if one of the 345-kV lines failed it would take out three 12-kV lines with it? It would take out three 120's? So a falling tower on the high line could leave you with one line.

MR. McKELVEY: That is right, in the worst scenario.

MR. RAY: Is the system stable under these conditions?

MR. McKELVEY: Yes. The system has been analyzed

with load flow and system stability programs for that kind of contingency.

MR. RAY: Using four lines you maintain stability of the system, it does not break up on you and thereby deny AC power to the system?

MR. McKELVEY: That is right.

MR. RAY: What kind of faults were assumed for that stability study? Can you tell me how comprehensive it was?

MR. McKELVEY: I did not take part in that stability study. I am afraid I cannot. I can get the information for you.

MR. RAY: The implications here are if you take out -- if there are four lines, one failure, they are all poly-phase, three-phase faults.

MR. McKELVEY: They are all three-phase faults, yes.

MR. COLBERT: Characteristically, all of our studies take into account all kinds of faults, that is three-phased faults, double phase to ground and single-phase faults. And we would take into account the various loss of generators under certain conditions with a reduced transmission system, and then see if the system remains stable and if the generators go out of step.

MR. KERR: Thank you.

Mr. Carbon?

MR. CARBON: Will a typical Midwestern tornado take down one of those power lines or all of them? Will it knock down some transmission lines like that?

MR. McKELVEY: In the common corridor?

MR. CARBON: There or anyplace, is the power line susceptible to being knocked down by a typical Midwest tornado.

MR. McKELVEY: Yes.

MR. RAY: It has happened.

MR. McKELVEY: However, I have one statistic. In the last ten years on the Detroit Edison system we have only lost two towers, two 345-kV towers to tornadoes.

MR. RAY: I notice in some of the background on your station -- I cannot say now where I picked it up, but on the Fermi site you have a 165 oil-fired unit and four small peaking units. Are these connected into the 120-kV system at that substation?

MR. McKELVEY: Yes. We will be getting into that if I can continue.

MR. CARBON: One more question. The supports for those transmission lines, are they designed to resist an SSE earthquake?

MR. McKELVEY: No, they are not.

MR. KERR: Please continue.

MR. McKELVEY: The two switchyards at Fermi 2 -- and this is a very brief description of them. The 120-kV switchyard is located at the Fermi 1 plant.

(Slide.)

It has three separate lines coming from the three separate stations. Two of the lines feed bus 102, with a tie to our bus 101. The Fermi 2 auxiliary electrical system offsite power feed is developed from that bus 102.

In the 345-kV switchyard we have two separate lines, as I said before, from our Brownstown station in a breaker and a half scheme. We also have the Fermi 2 generator, which generator voltage is transformed to the 345 transmission network. And also we have a tap off of bus 301 which feeds another system service transformer for the second source of offsite power.

I wanted to make a note that we do not use the unit auxiliary transformers to eliminate the switching.

MR. RAY: Is that bottom feed to the right that goes downward -- I cannot read it. The 120-kV, is that the point of connection of these other units that are on the Fermi site?

MR. McKELVEY: Right. The next slide will show that. Note that this is bus 102.

(Slide.)

The units in question, bus 102 and feed onto the

onsite power system, goes through a transformation down to an intermediate voltage where the peakers -- this symbolizes two peakers -- are tied into the system, two other peakers on a second wing. Those are for peaking duty. That voltage is again transformed through a system service transformer into our plant, into our ESF buses.

The two switchyards, I did not mention before, are located approximately a quarter mile apart, so they are very independent. The control power, the battery power, is also derived from separate battery stations.

The auxiliary electrical system is divided into two divisions. Again, one division is completely normal. Offsite power is fed from -- ultimately from the 345 and transformed down to two 4160-volt buses. Inside each division, each bus is backed by an emergency diesel generator at 4160 volts.

There are also associated 480-volt buses inside each division. They are divided up into load groups associated with each emergency diesel. We have intra-divisional ties between the 480-volt buses. Should either a bus or emergency diesel, for example, fail in an emergency situation, we could power one of a kind loads from either load group from the remaining diesel inside a division.

Similarly, for the division one power the ultimate

power source is the 120-kV system. Again there are two buses inside the division, backed by emergency transmissions for transmission at lower voltages. Again, any one of a kind type load could be powered from either remaining of the load groups.

MR. RAY: Where is the 165 megawatt oil-fired unit connected?

MR. McKELVEY: It was tied to the other bus, bus 101 in my previous slide.

MR. RAY: I see it. I am sorry, I missed it. Yes, thank you.

(Slide.)

MR. McKELVEY: Getting into --

MR. COLBERT: I think that should be pointed out that that is an oil-fired peaker. It is an economy reserve. It is not normally running. It has to be started up, and it can be started up in a relatively short time, half-start, meaning on the order of hours. That is, it would be on the order of two to three hours to start it up.

MR. RAY: If you lost all other AC power off the site, could you live while you were starting this unit up?

MR. COLBERT: Could you repeat that?

MR. RAY: If you lost all other transmission into the site and you had -- [illegible] diesels did not respond and there was an AC blac[illegible] [illegible]uld you start up this -- could

you survive while you started up this fossil unit?

MR. COLBERT: The term "survive," yes, we can black start that power plant. It is equipped with diesel engines to start with its own battery. By the way, that is not a small unit. That is 60 megawatts power.

MR. McKELVEY: You are sort of stealing my thunder.

MR. RAY: I was talking about the one big unit first.

MR. COLBERT: At the present moment that is an economy reserve and I was mistaken when I said it could be started in two to three hours. That would be if we were operational. But right now that plant is not manned. We have to make a conscious decision to send the people down there to man that plant.

MR. RAY: So you have your eye on --

MR. COLBERT: That is correct.

MR. RAY: How fast can they start?

MR. McKELVEY: Ten minutes.

MR. RAY: Are they gas turbines?

MR. McKELVEY: Yes.

MR. RAY: Good.

Excuse me. One last question. Somebody said 60 megawatts. Are there four 60's?

MR. McKELVEY: 480 megawatt units.

MR. RAY: What do you need to start the plant -- to shut down the plant safely? Do you have any idea?

MR. McKELVEY: Yes. All we need is one division power.

MR. RAY: How many megawatts is that?

MR. McKELVEY: That is approximately five megawatts. So we are well within the rating of one.

MR. ZUDANS: Only one of those four is a black start.

MR. LUSIS: A small addition. If we start one unit we can pick up the other three.

MR. McKELVEY: But there is really no need to do that.

MR. KERR: Please continue, Mr. McKelvey.

MR. McKELVEY: Getting into a failure analysis, for long-term cooling we need one of our two divisions to remain intact power supply-wise, and the loss of either division, as you can see, will be backed up by the second division. Loss of either division will result in the loss of that division's emergency core cooling.

(Slide.)

Loss of division one will also result in the loss of all power to the inboard isolation valves. However, in both cases we have divisional -- division two redundant equipment which can act to mitigate the accident.

Incidentally, the ECCS is shared among the four buses. For example, one RHR pump and one core spray pump are fed from each of the four buses and its associated valves are fed from the 480 volt bus associated with that load group.

The emergency diesel generator auxiliaries are on their own load group. They are also fed from that power train. Okay.

(Slide.)

Now, moving into the DC system.

MR. KERR: Mr. McKelvey, I do not want to rush you very much, but your time allocation shows 20 minutes and my watch shows you have already spent most of that. So we want the information, but talk a little faster.

MR. McKELVEY: Will do.

The Fermi DC system consists of five batteries. They are of similar design. Three are at -- graded at 260 volts, two at 48 volts. All five batteries are center-tapped for control at the half-voltage. Three -- one 260-volt and the two 48-volt batteries run non-ESF equipment.

The overhead I have up here right now shows you a typical for either of the two divisions. The batteries are sized for four hours based on a worst case design basis event without battery chargers. The battery chargers were

sized for being able to carry the continuous load while simultaneously recharging the battery within 16 hours.

In addition --

MR. ZUDANS: Can I ask a quick -- if you would not have batteries, just a charger by itself, could you use it?

MR. McKELVEY: Definitely.

MR. ZUDANS: How do you maintain the voltages?

MR. McKELVEY: The chargers have their own automatic voltage regulation.

MR. RAY: I presume you could carry such loads on the chargers indefinitely.

MR. McKELVEY: Yes, as long as the AC system remains intact.

MR. RAY: Yes, yes.

MR. McKELVEY: In addition, we have an installed spare battery charger which is able to be connected to either side of the battery to replace either of the two normally installed chargers, normally operating chargers.

Now, getting into a loss of DC, if we lost the division one 260-volt battery we would lose the function of the RCIC system, we would lose the ability to depressurize using the auto safety relief valves. We would also lose the control to division one ECCS, the division one switch gear and also the emergency diesels. However, the loss of this battery can be covered by the existence of the division two

battery and any AC that is available in the division two side.

Similarly, for a loss of the division two battery, we would lose the function of the HPCI system, the outboard isolation valves that are DC-powered, the control of division two ECCS, the switch gear and the diesels. Similarly, again, it can be covered by the remaining division one battery and AC sources for the redundant loads.

MR. RAY: A quickie. You said should you lose one division DC supply -- maybe I am interpreting this too broadly -- you could back up those loads from the other division.

MR. McKELVEY: Right.

MR. RAY: This says you have ties between the two divisions.

MR. McKELVEY: No, not the same loads. Redundant loads.

MR. RAY: Okay. So therefore you do not have communication between the two DC systems.

MR. McKELVEY: No, they are fully independent.

MR. RAY: Thank you.

MR. ZUDANS: If you lose division number one, you lose RCIC and that is not recoverable by any redundant means.

MR. McKELVEY: The HPSI system along with the ADS --

MR. ZUDANS: But not the RCIC. If you lose the other division, you lose division two and you have RCIC.

MR. McKELVEY: Right, right.

MR. ZUDANS: Okay. One is ECCS and the other is not.

MR. KERR: Any time Mr. Zudans hesitates, you start talking.

(Laughter.)

MR. McKELVEY: I guess, moving to the last of the station blackout, we feel that there is no single equipment failure on our site that can get us into a loss of both offsite power sources. Beyond that, we do not believe it is credible to lose both offsite power sources and also simultaneously lose four emergency diesel generators.

However, if such a highly unlikely event were posed, we could through the use of the black start peaker which was previously mentioned power one entire division. It is easily sized, as we mentioned before, to do so.

That was the conclusion of my presentation, unless you have some other questions.

MR. KERR: Are there other questions?

(No response.)

Mr. McKelvey, can you tell me if you have

calculated what is the probability that you will be without offsite power for two hours?

MR. McKELVEY: Our system planning department has done such a calculation. However, it does not take into account all potential offsite power losses, such as a tornado. It does take into account storm-related ones, ice, wind.

MR. CARBON: Sabotage?

MR. McKELVEY: Sabotage was not included, either. But we came up with a 10^{-5}.

MR. CARBON: This is 10^{-5} for the life of the plant or per year?

MR. McKELVEY: Per year.

MR. KERR: You did not take into account tornadoes?

MR. McKELVEY: We did not.

MR. KERR: Is that because you did not know how or you did not think a tornado was likely to occur?

MR. McKELVEY: We did not exactly know how. We are working on that, by the way, and plan to revise it.

MR. KERR: If you cannot do anything else, you will have to gin up a tornado.

MR. McKELVEY: Right. There are contingencies, by the way, for replacing poles in a rapid as possible situation to restore one line to the site should a tornado

go through our corridor.

MR. KERR: The 10^{-5} does take into account ice, I assume?

MR. McKELVEY: Yes.

MR. KERR: Any other questions? Mr. Carbon?

MR. CARBON: Is it impractical to design tower power lines against tornadoes or does it become just --

MR. McKELVEY: To the best of my knowledge, it is darn near impossible.

MR. CARBON: Okay.

MR. KERR: Max, there is a slight variation of that which no utility in its right mind would mention, but I will mention, and that is you put them on the ground. But --

(Laughter.)

MR. ZUDANS: And saying everything is possible

I have a question, a basic question. Why are the RCIC and the HPSI systems classified differently?

MR. McKELVEY: Classified differently?

MR. ZUDANS: In terms of safety grade.

MR. KERR: Mr. Colbert.

MR. COLBERT: Bill Colbert, technical director.

The HPSI is classified as class 1. It is class 1 backup, and the other division is actually the automatic ADS. The R-C-I-C is -- let's see, it is the reactor core

isolation cooling, and it was not designed originally to recover from an emergency, an accident, but an operating emergency. Why, way back 20 years ago, 10 years ago, that decision was made, I do not know. But the class 1-ness of the other division is the ADS valves. So you operate the ADS valves and you go back to your --

MR. ZUDANS: You lose one of your electric systems, you lose a HPSI with it, and you have no way of having high pressure injection. You have to depressurize. That is the normal procedure.

MR. COLBERT: You said if you lose HPSI. That is not true. You do have RCIC.

MR. ZUDANS: No, I think RCIC is not in the same category. It does not have to be there. It does not have to survive. In other words, it is a lower quality type of device and therefore in the case of some postulated situation it does not have to be there. It cannot be counted as a backup in your ECCS calculation.

MR. COLBERT: That is correct.

MR. ZUDANS: Therefore it is not there.

MR. KERR: But in real life it is there.

MR. ZUDANS: That is right.

Now -- and it is a very nice thing to have. I am wondering, what is the philosophy? Actually, not the utility, the NRC should tell us why they do not put this in

the same --

MR. KERR: Tomorrow morning at 8:00 o'clock.

(Laughter.)

MR. KERR: Okay. Any other questions of Mr. McKelvey?

(No response.)

Thank you, sir.

MR. LEHNERT: My name is Dan Lehnert, system engineer, Detroit Edison. And the topic is the Mark I containment issue. And what I would like to do is briefly describe the nature of the containment, primary containment design at Fermi 2, the plant-unique program for resolving the Mark I containment issue, and identify for you the results of our implementation efforts.

(Slide.)

The primary containment at Fermi 2 is a steel shaped structure designated by GE to be a Mark I containment. This slide shows the primary containment in an elevated sectional diagram. As you see here, it being the drywell, it is an inverted lightbulb shape connected to a torus-shaped wetwell or suppression pool, and it is interconnected with the drywell in the suppression pool between the vent line, vent header, and the downcomers.

The original design -- the primary containment was designed, erected for the ASME section 3 during the early

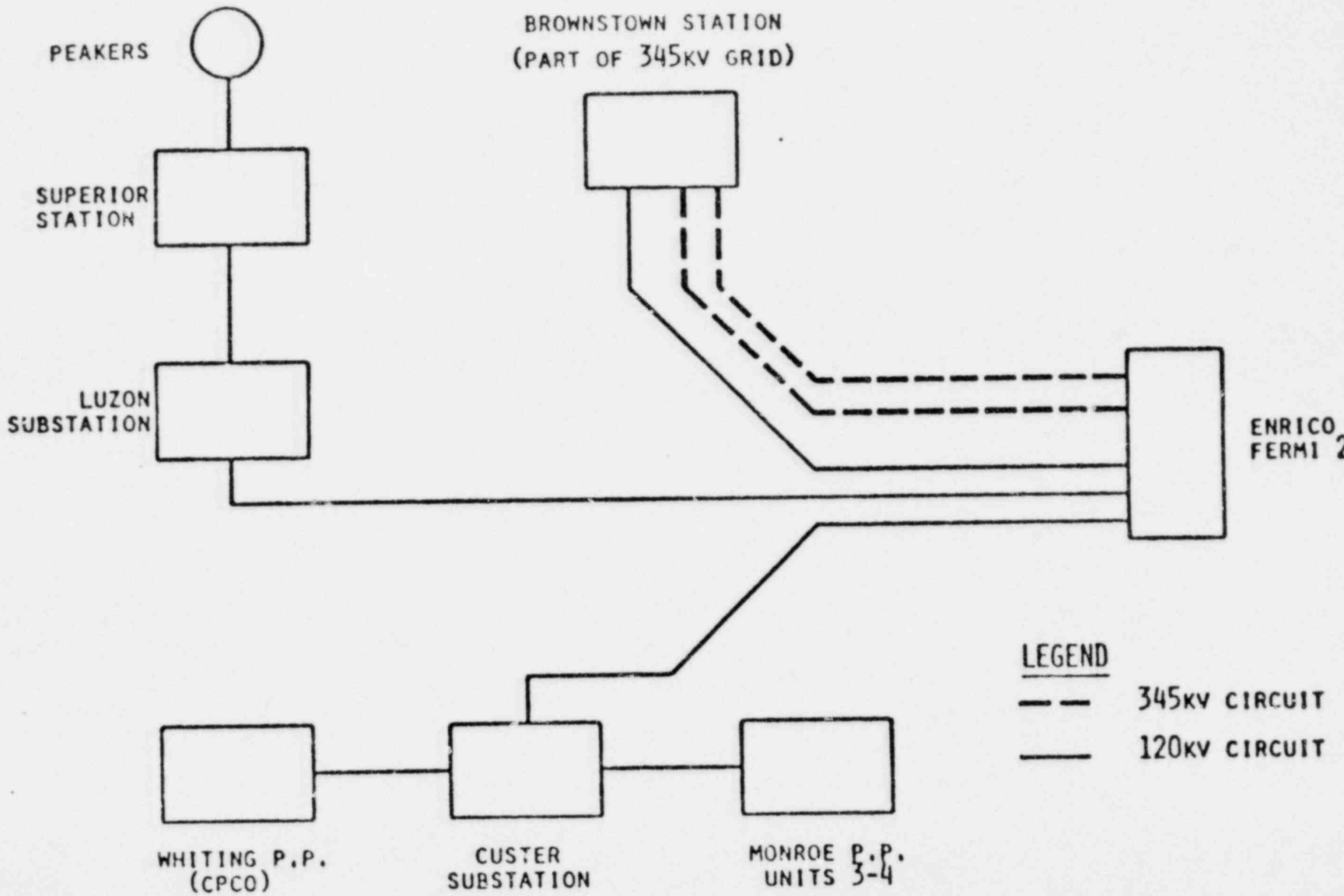

FIG. 1 ENRICO FERMI 2 OFFSITE POWER SOURCES

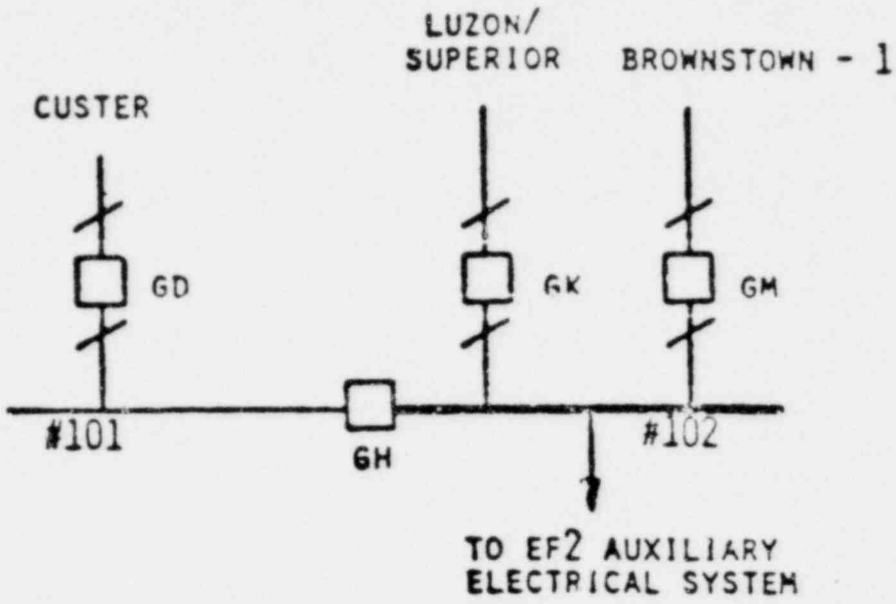

FIG. 2 ENRICO FERMI I 120KV SWITCHYARD

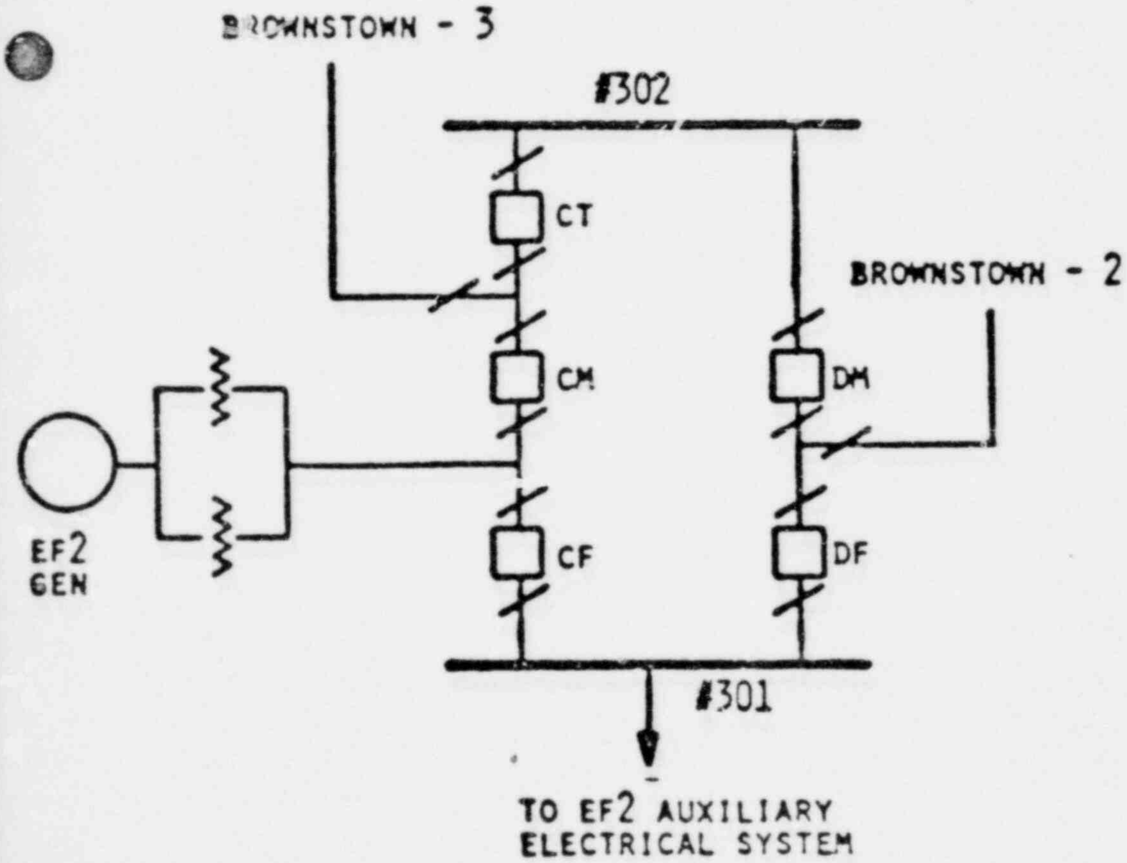

FIG. 3 ENRICO FERMI 2 345KV SWITCHYARD

II. G-14

* PEAKER NO. 1 IS USED FOR BLACKSTART

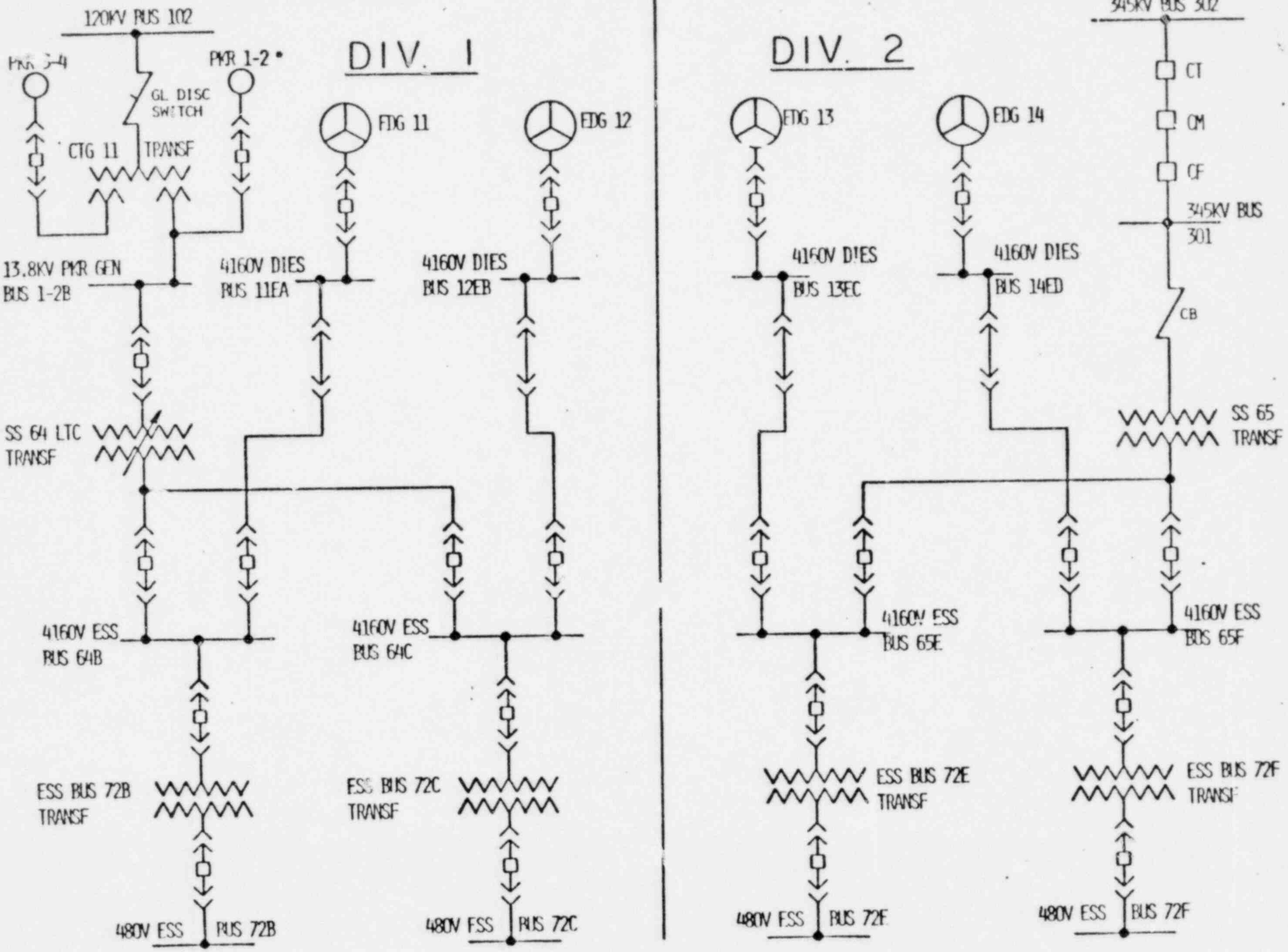

FIG. 4 ENRICO FERMI 2 AUXILIARY ELECTRICAL SYSTEM

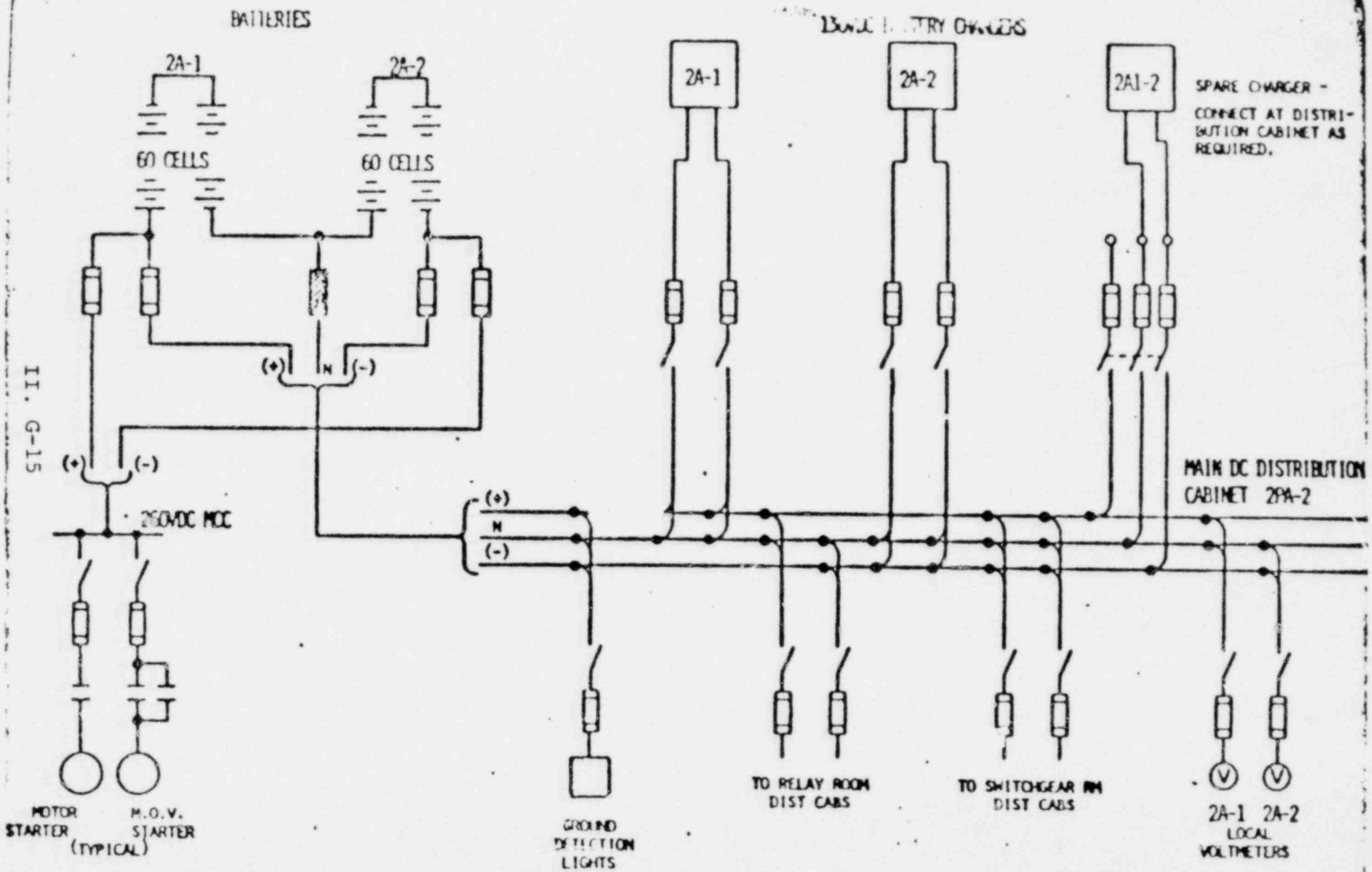

FIG. 5 ENRICO FERMI 2 260/130VDC DISTRIBUTION SYSTEM

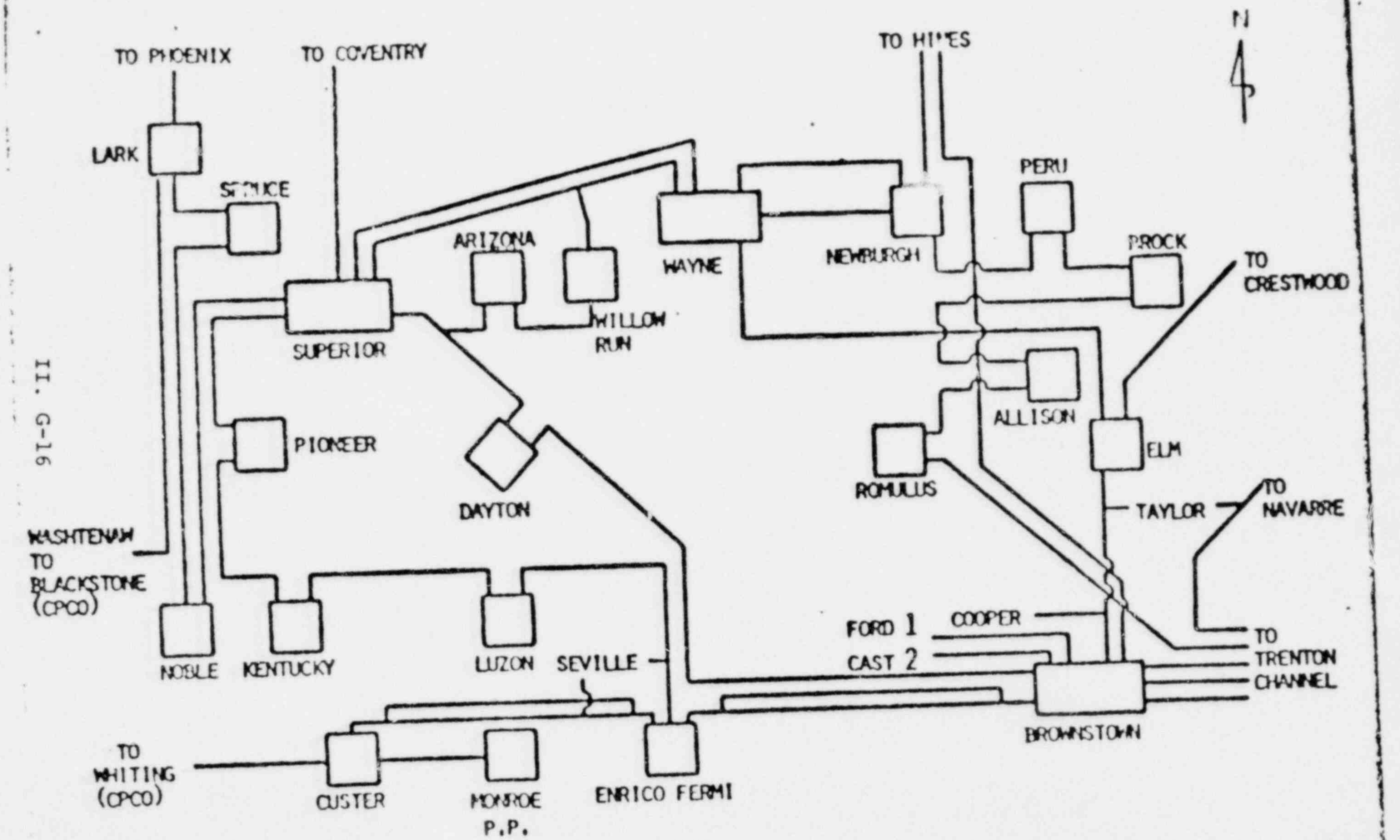

FIG. 6 120KV TRANSMISSION IN 1983 - SOUTH AREA

II. G-16

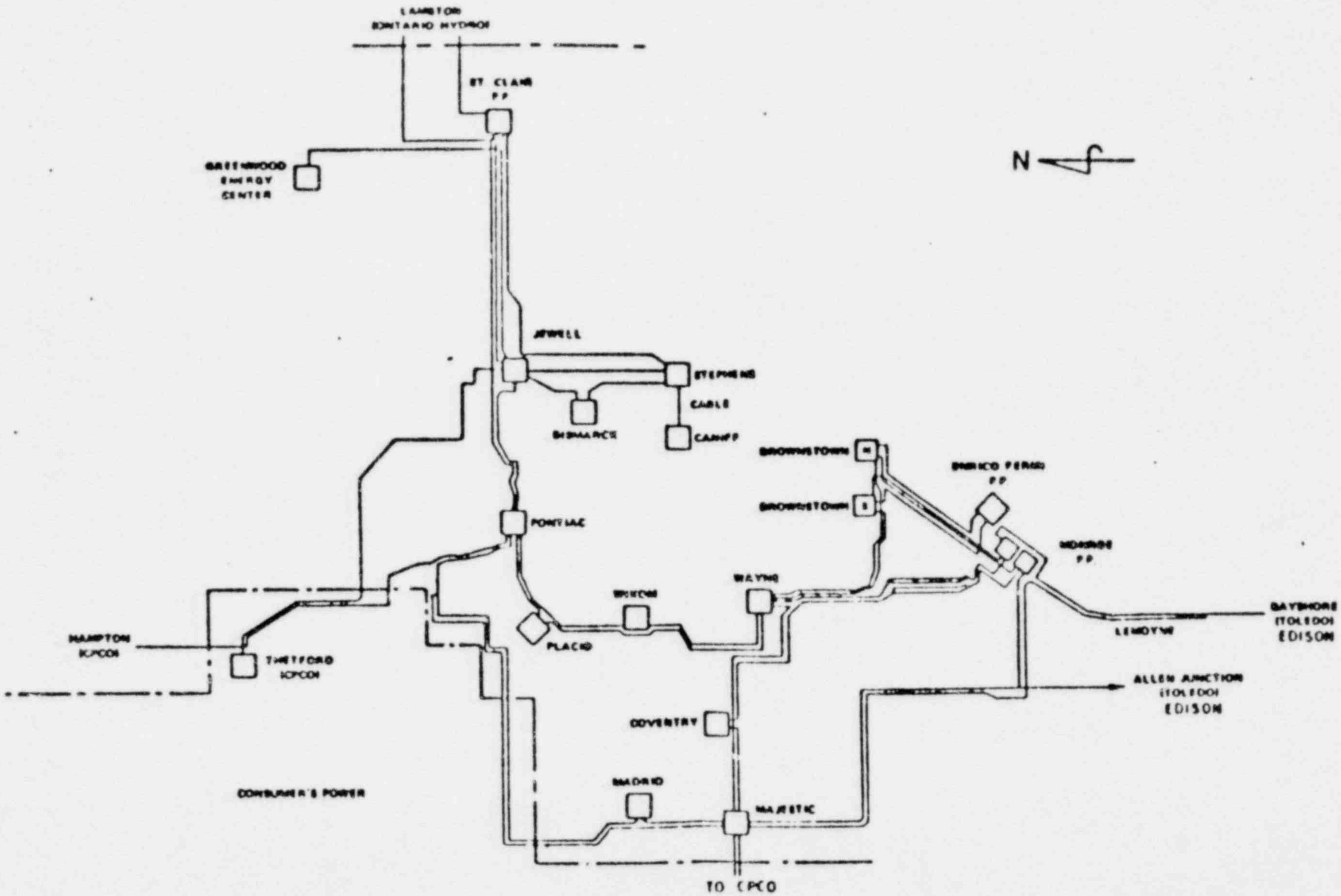

FIG 7 345KV TRANSMISSION IN 1983