TESTIMONY OF GORDON L. HEINS

My name is Gordon L. Heins. I live at 419 Steward, Jackson, Michigan. I am a graduate of Vanderbilt University (Nashville, Tennessee) with a Bachelor of Engineering Degree in Electrical Engineering (June 1952). I have done graduate work at the University of Michigan, Michigan State University, Massachusetts Institute of Technology and Columbia University in electrical engineering, economics, statistical analysis and business administration.

Upon graduation from Vanderbilt University, I was employed by Allis Chalmers Manufacturing Company for 2½ years, including a period in the Nuclear Power Department. I served in the U. S. Army as an instructor in the Ordnance School at the Aberdeen Proving Grounds for two years. Upon discharge from the Army I was employed by Consumers Power. The first nine months of my employment were in substation design. Since that time, from approximately June 1957, I have been involved in planning. I was appointed to my present position on January 14, 1976. Prior to that time, I had held the following management positions: Executive Manager, Electric Planning; Principal Engineer, Transmission System Planning Department; Head, System Planning Division, Electric and General Engineering Department; and Head, Distribution and Transmission System Planning Section, Planning Division, Electric and General Engineering Department and several other supervisory positions. I am a Registered Professional Engineer in the State of Michigan and a member of the Institute of Electrical and Electronic Engineers and of its Power System Engineering Committee. I serve on the Board of Trustees of the Michigan Energy and Resource Research Association.

I am responsible in my present position for planning gas and electric bulk energy facilities; addition and retirement of electric generating facilities;

interconnections with other electric power systems; negotiating power interchange, purchase and sale agreements, except wholesale for resale, with other electric power entities; planning the bulk energy system; engineering the systems and maintaining the facilities required for protection of the electric bulk power transmission system; and providing laboratory services. I also have charge of gas and electric research and development, and land and right of way matters.

I Load Forecasting

The starting point in the analysis and planning necessary to the performance of my responsibilities is the forecasting of energy sales to customers. The long-term forecast of electric energy sales is the one which is relevant to this proceeding, since we are looking at the question of the need for the Midland Plant's capacity in 1981-82 and thereafter. This forecast for a given year has been derived as follows: Starting with estimated 1976 energy sales, a short-term projection method is used to obtain a 1977 sales estimate. We are estimating a 3.5% sales increase for 1977 over 1976. Beyond 1977, a 5.2% increase is anticipated each year in electric energy sales through the mid-1980s. The 5.2% growth factor is applied for each year beginning with the 1977 base year.

The long-term electric energy sales forecast is based on the following key assumptions:

A. Residential. The population in the Consumers Power service area is projected to grow at an annual rate of 1.6%. Residential domestic average use is expected to grow at approximately 2% per year through 1990, compared with about a 4% annual growth during the 1960's. This reduced growth rate reflects conservation and price elasticity as well as the development and promotion of more efficient appliances. The foregoing assumptions result in a projection of growth for total residential sales at an annual rate of approximately 5.2% through 1986, as compared to an annual growth rate of about 6.5% for the 1964-74 period. These projections would be for an even lower rate of growth were it not expected that shortage of alternate fuels will cause an increasing saturation of residential electric space heating.

B. Commercial. The historic annual growth rate of the Consumers Power commercial electric sales is 9%. However, the projection of future commercial sales growth is 5.5% per year. This reduced growth forecast is due to conservation, price elasticity and the belief that commercial lighting and air conditioning have already reached a high saturation level. The potential for greater use of electricity for space heating and water heating, as other fuels become less readily available, is an off-setting factor to the decline in growth rate.

C. Industrial. The forecasted long-term annual growth rate for industrial sales in the future is approximately 5%, compared to one of about 7% experienced in the 1960's and early 1970's. In part, this decrease in growth rate reflects the production of smaller cars, moderate increases in annual car sales and the anticipated Michigan car production levels. This forecast reflects the experience of Consumers Power's major industrial customers and of its industrial customers as a whole in conservation of energy and further reflects anticipated future effects of energy conservation.

Over the next 10-year period, it is expected that residential, commercial and industrial energy sales will comprise approximately 32%, 23% and 41%, respectively, of total energy sales to the ultimate consumer. The foregoing class-by-class projections result in a total energy sales forecast of 5.2% annual growth.

Since the sales forecasts measure energy requirements at the point of sale and energy losses take place between the generation facilities and the point of sale, the sales forecasts must be divided by an efficiency factor in order to determine the amount of generation necessary to meet the sales forecasts. This efficiency factor is the ratio of sales to generation calculated on the basis of historical trends as modified to reflect known or expected factors influencing efficiency. Application of the efficiency factor results in an estimate of the total generation requirement in kWh necessary to meet the annual sales forecast.

Consumers Power's annual expected peak load is then calculated by dividing the average demand (total generation requirement divided by number of hours in the year) by the estimated annual load factor for the year. The annual load factor is the ratio of average demand to peak demand and is developed from historical relationships and adjusted to reflect current and expected future conditions affecting load factor, such as energy conservation, pricing of energy, availability of gas and its resultant effect on use of electricity for heating, load management and general economic conditions. Consumers Power's load factor for years subsequent to 1978 is estimated at 67%. The Consumers Power system historically experiences both a summer and winter peak demand, and both are computed using this load factor.

Once projected peak load demands are known, the requirements for installed generating capacity are determined as described in Section II of my testimony below.

One important factor in the determination of needed generating capacity is the effect of what is generally termed energy conservation. Two distinct aspects of this factor must be addressed:

1. Energy conservation is usually a self-motivated or induced action on the part of the customer to use less energy. Such action tends to reduce utility energy sales and may or may not affect peak generation requirements.
2. The second point has to do with the possibility of increasing system load factor using various methods in order to move some customer usage to off-peak time periods. For example, time-of-day rates and load management control tend to accomplish this. The intended effect is to increase the use of existing generation and delay the need for installing additional generating capacity.

Deeper analysis will reveal that the shifting of load can occur on the part of the user or on the part of the supplying utility. For example: Consumers Power Company, some years ago, built and placed in operation the Ludington

Pumped Storage Plant which utilizes generating capacity during off-peak load periods to provide capacity and energy for use during peak load periods.

The expected customer load factor of 67% on Consumers Power's system is already quite high. The system load factor is further increased to approximately 80% by the operation of the Ludington Pumped Storage Plant. This leaves little room for shifting on-peak usage to off-peak usage. Difficulty sometimes occurs now when attempting to schedule maintenance, due to the small differential between peak and off-peak periods.

As I have pointed out, the experience with regard to energy conservation measures already in effect in the Consumers Power service area and expectations as to the continued effect of such measures, and of the effect of measures which Consumers expects may be taken and prove efficacious in the future, have been factored into the electric energy sales projections and, consequently, into the generation and demand forecasts.

Conservation effect measurement commenced immediately after the late fall 1973 appeal for energy conservation by President Nixon. Such measurements were confined to residential and commercial customers. There were significant conservation effects observed in the first winter season (1973-1974). Consumption in the measured groups was down 4.5% over the corresponding year earlier period. In the second heating season, usage was up 1.5% over the comparable 1973-1974 period and in the third heating season, usage rose 0.7% more.

Residential electric space heating customers showed a reduction of 7.8% the first heating season; a further reduction of 5.9% in the second heating season; and a 2.2% reduction in the third. It is believed that the larger relative bill size for greater kWh has motivated these customers to conserve.

Air-conditioning customers reduced their usage in June but showed little change in July and August. This pattern indicated that the customers delayed startup of their units, followed previous usage patterns once the units were in operation. Thus, their air-conditioning use would impact fully on the summer peak load, which usually occurs during a hot spell in July or August.

Industrial customers have utilized our Energy Consulting Services Department and have reduced lighting levels and ventilation energy use; kept facilities cooler in winter and warmer in summer; reduced air compressor pressures and usage; reduced hot water temperature, and perhaps taken other steps. The exact level of industrial customer conservation is difficult to assess since it is mixed in with production changes.

Moreover, Consumers Power has studied, or is currently engaged in studying, either on its own or as part of an industry effort, a variety of suggested energy conservation measures, such as, studies relating to the efficacy of heat pumps, the effect of flat rate and inverted rate structures; marginal cost pricing; and other concepts. Additional studies are in progress to assess the probable effect of measures designed to reduce demands at peak load periods, including remote control of loads such as water heaters, air conditioners, electric space heating and refrigeration, and time-of-day rates. At this point in time, we do not believe that these concepts will be implemented within our service area to such an extent and within a time period such that they will significantly affect energy sales forecasts for the early 1980s. Some of these concepts are of questionable validity. Others are of questionable practicality because of the very high cost of metering equipment (for example, $200 to $400 per customer for meters required to effect time-of-day pricing) or other required equipment. Still others are questionable because of their potential side effects, such as the possibility that inverted rate structures will seriously affect the economy within Consumers Power's service area. We would expect Consumers Power and the Michigan Public Service Commission to study these proposals carefully over a substantial period of time before attempting to put any of them into effect. Even if some of the energy conservation measures should prove to result in sound energy conservation programs, we would expect their effect to be felt later than the period in question in this proceeding.

II. Generation Planning Methodology and Reserves

Sufficient generating capability must be planned to reliably serve projected electrical demands. The capability needed includes an amount sufficient to meet loads and an additional reserve amount to continue supply when generating units are down for maintenance or because of equipment failure. Generation plans are formulated to meet those requirements.

The amount of reserve generating capacity needed to maintain reliability is dependent upon several parameters, including generating unit size and performance, load characteristics, design reliability level and interconnection supports. Using probability theory, the projected reliability of the generating system can be assessed and the relationship between system reliability and reserve level determined.

For planning purposes, Consumers Power Company's present reliability goal is that the loss of load probability is equivalent to one day in ten years. The term "loss of load" refers to an event where, due to a high load or coincident equipment failure the total amount of generation available to operate, including power available from other utilities, is not sufficient to totally serve customer demand and the load must be disconnected or other action taken to prevent system collapse.

Under presently forecasted conditions, Consumers Power Company requires total reserves equivalent to 50% to 60% of its peak load in order to satisfy the reliability criterion. Considering the backup power which is normally available from other utilities, we estimate that installed generation reserves should be equivalent to approximately 20% of the projected load.

III. Impact of Midland Delay or Cancellation on Reserves

A. Capacity Reserves

The projected capability of the Midland Plant is 1271 MW. Two cooperative and two municipal systems in Michigan are negotiating a shared ownership interest in the plant to secure an aggregate amount of 272 MW of capacity, although current plans call for the Company to buy back a portion of this capacity in the early years of plant operation.

The effect on Consumers Power Company's capacity reserves of the power available from the Midland Plant has been projected, based on the load projections discussed earlier. For purposes of these calculations, we have included the capacity needed by the systems purchasing portions of Midland's output. This amounts to the above-mentioned 272 MW, less the amount which will be available for buyback by Consumers Power.

Our present planning encompasses consideration of the risk of continued deterioration of the steam generators at the Company's Palisades Plant and concomitant reduction of its generating capability. For planning capacity purposes, this translates into a 5% (approximately 35 MW) per year capability reduction. In addition, we plan a two-year outage, tied to the in-service date of Midland 2, in order to effect repairs to the plant. It is assumed that these repairs will allow recovery of the full capability of the unit.

Consumers Powers proposed Exhibit 11, which is attached, details Consumers Power's projected reserve situation and the impact of possible delays in the Midland units' in-service dates. The cases shown are:

1. Midland As Scheduled (3-1-81 & 82)
2. Midland Delayed to 12-1-81 & 82
3. Midland Delayed to 6-1-82 & 83

Also shown for reference are reserve levels if Midland were not added at all in this period. Since summer is the critical period considered in these reserve calculations, a delay of Midland to either December 1981 and 1982 or June 1982 and 1983, results in the same summer reserve levels.

From the data shown in Exhibit , we conclude that delay of the Midland units would result in marginal reserves of 18% in 1981 and clearly inadequate reserves of 15.7% by 1982. This is based on our required reserve level of 20%.

Included in Consumers Power Company's projected capacity for the 1981-1984 period as shown in Exhibit 11 is 2194 MW of oil and gas fired capability (summer rating). Of this, 1568 MW at our Karn-Weadock complex are directly fired with oil imported from Canada. While we have contracted for adequate fuel supplies for these units through 1981, delivery is contingent upon continuing approval by the Canadian National Energy Board and U. S. authorities. Curtailment of contract deliveries or the refusal or inability of suppliers to extend the contracts beyond 1981 could result in inadequate oil supplies for Karn and Weadock. The availability of alternate fuel oil supplies after 1981 is extremely difficult to assess at this time. Thus, this supply is exposed to changing economic and political factors and long-term supplies cannot be assured.

Consumers Power Company's exposure to this risk can be gauged by reviewing the impact of loss of oil-fired capacity at Karn-Weadock on Consumers Power proposed reserves. Exhibit 12, which is attached, repeats the scenarios of Exhibit 11, but with the loss of 1586 MW of generating capability. Even with the Midland units in service as scheduled, reserves are totally inadequate. Considering the extremely limited availability of assistance from other utilities, interruptions to service could be expected. The impact of a delay of Midland in addition to this contingency would be severe. Frequent service interruptions would be expected and severe hardships would be suffered by our customers.

B. Energy Supplies

An additional indication of the impact of a delay of Midland on reliability of supply can be gained through review of the overall ability of Consumers Power Company's generating units to meet the energy needs of its customers. Consumers Power proposed Exhibit 13, which is attached hereto, compares Consumers Power Company's annual energy supply capability with annual generation requirements. The scenarios shown are comparable with those of Exhibit 11.

For purposes of Exhibit 13, energy supply capability was calculated as the summation of the maximum amounts of generation which could be expected from each generating unit taking due regard of unit availability, maximum continuous loadings and, where applicable, fuel supply limitation. It is assumed that customer loads do not vary from normal patterns to such an extent that an abnormally high peak load occurs.

If Midland goes on line as scheduled, energy supplies are marginal in 1981, but improve thereafter. Delaying Midland, however, results in significant shortfalls. As the length of the delay is extended, the insufficiency becomes increasingly acute.

These shortages would impact on our customers to the extent that energy could not be purchased from other utilities. Severe measures such as selective load curtailment would become necessary.

C. Availability of Purchased Power

Presently, Consumers Power's sources of purchased power include The Detroit Edison Company, Ontario Hydro and the ECAR companies, particularly American Electric Power. At this time, however, the availability of excess power during the period 1981 through 1984 from these utilities is highly questionable. The Detroit Edison Company, with whom Consumers Power has an electric coordination agreement providing for mutual support, presently projects installed generation reserves such that surplus power and energy are not indicated for 1981-1983. Ontario Hydro, with whom Consumers Power and The Detroit Edison Company are joint parties to an interconnection agreement providing for power purchases to alleviate deficiencies, has by letter indicated its concern over its own supply and inquired as to the availability of firm power from Michigan from the early 1980s onward. This would indicate that little or no support from Ontario Hydro will be available. Further, the ECAR companies have projected reserve levels below 20% in the early 1980s. This is as reported to the FPC pursuant to Order 383-3, April 1976.

The uncertain availability of power from other utilities affects not only the ability of Consumers Power to withstand a reduction in reserve from the planned 20 percent level, but also introduces an additional degree of risk into that planned reserve level as well. With the supply of backup power relatively less assured in the 1981 through 1984 period, planned reserves in excess of 20 percent would not be imprudent.

IV. Impact of Midland Delay or Abandonment on System Operating Cost and Fuel Usage

Operating Cost Increases Due to Delay

Should Midland be delayed, the electrical energy which would have been generated by the units must be obtained from other sources in order to continue to supply energy to our customers. These sources are the remaining generating units on the Company's system and other utilities with which Consumers Power Company is interconnected. Since Midland is a low cost of energy unit, the cost of energy to replace it will exceed Midland's own energy cost. Thus, the delay of Midland will result in the Company's customers having to pay higher fuel and purchased power costs in the price of the electricity they use in the period 1981 through 1984.

Implicit in the analysis to follow is an assumption that purchased power will be available as needed. As mentioned earlier, there is no assurance that such power will, in fact, be available.

The additional costs associated were estimated using a computer program which simulates the action of the generating system to meet customer demands. By performing simulations with the in-service date of Midland as scheduled and then delayed, the additional costs of such delay can be estimated. While the effects of the assumed delays extend beyond 1984 because of the interaction of the Palisades outage and the Midland in-service dates, the 1981 to 1984 period encompasses the most significant effects.

Consumers Power proposed Exhibit 14, which is attached, summarizes the net additional fuel and purchased power costs conservatively estimated to result from delaying the Midland units from their current schedule. In arriving at these estimates, sufficient purchased power from parties other than Detroit Edison was assumed available to meet the Company's 20% reserve criterion over summer peak load when the delay extended over the summer months. Further power was assumed available and purchased when generating unit outages exceeded available reserves and, finally, the Company's normal exchanges with The Detroit Edison Company were also simulated.

Operating Cost Increases Due to Abandonment

Exhibit 14 also lists estimates of the net additional fuel and purchased power expenses to be incurred between the scheduled in-service dates of the Midland units and when alternative generation might be added. Note that the figure shown for 1984 assumes no addition of replacement generating capacity in that year. Should replacement capacity be added during 1984, a reasonable estimating methodology is to scale the figure shown for that year to the proportion of the year during which the alternative capacity is not available.

The figures listed for this case were calculated in a similar fashion to those for the delay case. However, the assumption was made that the entire amount of megawatt-years of lost generating capacity due to this abandonment of Midland would be made up through additional higher cost fossil fuel generation and purchased power during the years 1981-1984, whereas Consumers Power would actually plan to continue to operate Palisades throughout this period to partially offset the loss of Midland and would take Palisades out of service only after the alternative to the Midland unit was placed in service. This Palisades outage would extend to the years 1985-86 and higher cost fossil fuel generation and purchased power would then be required to offset the Palisades outage in those years. Consequently, the effect of the abandonment of Midland would actually extend throughout the period 1981-1986. In order to avoid modelling the 1985-86 years, the entire effect was reflected in the period 1981-1984.

In addition to the above-mentioned economic costs incurred, the delay or abandonment of Midland will also result in increased fossil fuel usage, both by Consumers Power and the utilities from which it would purchase power. Based on the simulations done for these cases, the additional fossil fuels burned by Consumers Power are set forth in Consumers Power proposed Exhibit 15, which is attached.

A reduction will be noted for 1984 in one case. This relates to assumed purchases of power from other utilities and represents a transfer of the additional consumption of fuel from the Consumers Power system to other systems.

CONCLUSION

The foregoing analyses with regard to availability of reserve capacity in 1981 to 1984, adequacy of energy supply for the same period, differential fuel and purchase power cost for the same period, and additional consumption of fossil fuel for the same period, demonstrate the need for the Midland facility to be available for commercial operation on the currently scheduled dates.

CONSUMERS POWER COMPANY
Effect of Midland Delay on Reserves
(Summer)

Year		As Scheduled	Delay Midland to 12-81 & 82 or 6-82 & 83	Midland Not Added
1981	Cap	7292	6991	6991
	Purch	(472)	(432)	(432)
	Net Cap	6820	6559	6559
	Load	5560	5560	5560
	Res	1260	999	999
	% Res	22.7	18.0	18.0
1982	Cap	7752	7292	6956
	Purch	(536)	(536)	(473)
	Net Cap	7216	6756	6483
	Load	5840	5840	5840
	Res	1376	916	643
	% Res	23.6	15.7	11.0
1983	Cap	8438	7752	6921
	Purch	(552)	(552)	(473)
	Net Cap	7886	7200	6448
	Load	6150	6150	6150
	Res	1736	1050	298
	% Res	28.2	17.1	4.8
1984	Cap	8438	8438	
	Purch	(409)	(409)	
	Net Cap	8029	8029	
	Load	6450	6450	
	Res	1579	1579	
	% Res	24.4	24.4	

CONSUMERS POWER COMPANY
Effect of Midland Delay on Reserves
(Summer)
(Assuming Karn-Weadock Out of Service)

Year		As Scheduled	Delay to 12-81 & 82 or 6-82 & 83	Cancel Midland
1981	Cap	5706	5405	5405
	Purch	(472)	(432)	(432)
	Net Cap	5234	4973	4973
	Load	5560	5560	5560
	Res	(326)	(587)	(587)
	% Res	(5.9)	(10.6)	(10.6)
1982	Cap	6166	5706	5370
	Purch	(536)	(536)	(473)
	Net Cap	5630	5170	4897
	Load	5840	5840	5840
	Res	(210)	(670)	(943)
	% Res	(3.6)	(11.5)	(16.1,
1983	Cap	6852	6166	5335
	Purch	(552)	(552)	(473)
	Net Cap	6300	5614	4862
	Load	6150	6150	6150
	Res	150	(536)	(1288)
	% Res	2.4	(8.7)	(20.9)
1984	Cap	6852	6852	
	Purch	(409)	(409)	
	Net Cap	6443	6443	
	Load	6450	6450	
	Res	(7)	(7)	
	% Res	(0.1)	(0.1)	

CONSUMERS POWER COMPANY
Effect of Midland Delay on Energy Supply
(Annual Basis)
Gigawatthours

Year		As Scheduled	Delay to 12-81 & 82	Delay to 6-82 & 83	Midland Not Added
1981	Generation	32,907	32,347	31,400	32,276
	Requirements	32,607	32,607	32,607	32,607
	Reserve	300	(260)	(1,207)	(331)
1982	Generation	36,865	34,740	34,204	32,597
	Requirements	34,302	34,302	34,302	34,302
	Reserve	2,563	438	(98)	(1,705)
1983	Generation	39,377	36,013	34,652	31,154
	Requirements	36,085	36,085	36,085	36,085
	Reserve	3,292	(72)	(1,433)	(4,931)
1984	Generation	40,665	41,593	39,461	32,576*
	Requirements	37,962	37,962	37,962	37,962
	Reserve	2,703	3,631	1,499	(5,386)

*Assumes alternative generation not added in 1984.

CONSUMERS POWER COMPANY
Additional Fuel and Purchased Power Cost
Due to Delay of Midland from 3-81 & 82
Millions of Dollars

Year	Midland Delayed to 12-81 & 82	Midland Delayed to 6-82 & 83	Midland Not Added
1981	32	71	147
1982	72	88	226
1983	143	210	256
1984	0*	49*	234**

*Normalized to Palisades generation differential over the period 1984-1986.

**Additional cost if alternative generation not added in 1984.

CONSUMERS POWER COMPANY
Additional Fossil Fuel Consumed
Due to Delay of Midland From 3-81 & 82

Year		Midland Delayed to 12-81 & 82*	Midland Delayed to 6-82 & 83*	Midland Not Added*
1981	Coal	75	120	370
	Oil	510	1140	2490
	Gas	370	1050	1700
1982	Coal	150	160	540
	Oil	460	530	1890
	Gas	360	500	1570
1983	Coal	230	290	370
	Oil	1040	1490	720
	Gas	1250	1820	610
1984	Coal	0	90 (2)	193 (3)
	Oil (1)	0	600 (2)	(320) (3)
	Gas	0	0	0

Notes: (1) Presently gas fired combustion turbines were assumed converted to oil firing as of 1984.
(2) Fuel usage for 1984 normalized to differential over the period 1984-1986.
(3) Additional usage if alternative generation not added in 1984.
* Coal in thousand tons. Oil in thousand barrels. Gas in MMCF.

UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

Before the Atomic Safety and Licensing Board

In the Matter of	)	
CONSUMERS POWER COMPANY	)	
(Midland Plant, Units 1 & 2)	)	Docket Nos. 50-329 50-330

CERTIFICATE OF SERVICE

I certify that copies of the attached Testimony of Gilbert S. Keeley, Roy A. Wells, Jr., Joseph G. Temple, Stephen H. Howell, and Gordon L. Heins, dated November 5, 1976, were served upon the following by deposit in the United States Mail, postage prepaid and properly addressed, on this 5th day of November, 1976.

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