ML224

April 21, 1982

MEMORANDUM FOR: C. Siess, Acting Chairman, ACRS Subcommittee on Midland Plant Units 1 & 2

FROM: D. Fischer, Reactor Engineer

SUBJECT: PROJECT STATUS REPORT FOR THE ACRS SUBCOMMITTEE MEETING ON MIDLAND PLANT UNITS 1 & 2 - APRIL 29, 1982 - WASHINGTON, DC

Attached is a project status report for the subject meeting. The purpose of the meeting is to discuss remedial action being taken by Consumers Power Company regarding the Midland soils and structural settlement issues.

The meeting will begin at 8:30 a.m. on April 29, 1982 and will be held in Room 1046 at 1717 H Street, NW, Washington, DC. Attendance by the following ACRS members and consultants is anticipated and hotel reservations have been made as indicated. If anyone is unable to make the meeting, please call us or the hotel and cancel your reservations so that were are not billed.

| | | |
|---|---|---|
| C. Siess | Park Central (202-393-4700) | April 28 |
| W. Mathis | Army-Navy Club (202-628-8400) | April 28 |
| J. Osterberg | None | |
| R. Scavuzzo | None | |
| Z. Zudans | None | |

Attachment:
Project Status Report

cc: ACRS Members
R. Fraley
M. Libarkin
T. McCreless
J. McKinley
G. Quittschreiber

File: Midland 1 & 2

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| OFFICE | | | | | | | |
|---|---|---|---|---|---|---|---|
| SURNAME | RFischer:mcb | | | | | | |
| DATE | 4/ /82 | | | | | | |

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# MIDLAND PLANT UNITS 1 & 2
# OPERATING LICENSE REVIEW
# APRIL 29, 1982

## - PROJECT STATUS REPORT -

PURPOSE:

The purpose of this meeting is to discuss remedial action being taken by Consumers Power Company regarding the Midland soils and structural settlement issues.

BACKGROUND:

Pertinent facts concerning the Midland Project include:

Location:

The Midland site is located partially within the city of Midland, Midland County, Michigan. The city of Midland is approximately 105 miles NNW of Detroit and about half way up Michigan's lower peninsula on the Lake Huron (east) side. The facility is located along the south shore of the Tittabawassee River and south of the city of Midland. The site is adjacent to the Dow Chemical Company's (Dow) main industrial complex in Midland (located on the north side of the Tittabawassee River and due north of the plant). Within 10 miles of the plant, the 1970 estimated population was 72,706, within 5 miles, there were 48,501 residents. Circulating water for the two units is obtained from a cooling pond. The cooling pond receives make-up water from the Tittabawassee River. A map of the Midland plant site is included as Attachment 1.

Plant:

Unit 1 and Unit 2 each consist of a Babcock & Wilcox pressurized water reactor, a turbine generator, and associated auxiliaries. The two units have a combined capability of approximately 1,300 MWe and 4 million lb/hr of process steam. The process steam will be supplied to Dow and the electricity to the utility's customers. The containment for the nuclear steam supply system (NSSS) is a post-tensioned, reinforced concrete structure with a steel liner to provide leak tightness. The containment which was designed and constructed by Bechtel Power Corporation has a design pressure of 70 psig. The requested power level per unit is 2,452 MWt [NSSS output = 2452 MWt + 16 MWt (Reactor Coolant Pump heat input)]. The Unit 1 turbine generator (GE) is rated for operating at the NSSS rated output with a corresponding electrical output of 504.8 MWe. Process steam is provided to Dow by using extraction steam from the high pressure turbine under normal operation, and main steam from the main steam header. About 4 million lb/hr of process steam can be provided to Dow at the Unit 1 turbine generator rated level of 504.8 MWe. The Unit 2 turbine generator (GE) is rated for operation at NSSS rated output with a corresponding electrical output of 852 MWe. Each unit will use two B&W once-through steam generators. The reactor cores will

be loaded with 177 fuel assemblies (15x15). The core will have an average thermal output of 5.47 kw/ft (based on cold BOL data). The SSE is 0.12 g horizontal, 0.8 g vertical. The OBE is 0.06 g horizontal, 0.05 g vertical. A comparison of Midland features with those of similar plant designs is included as Attachment 2.

ADDITIONAL CONSIDERATIONS:

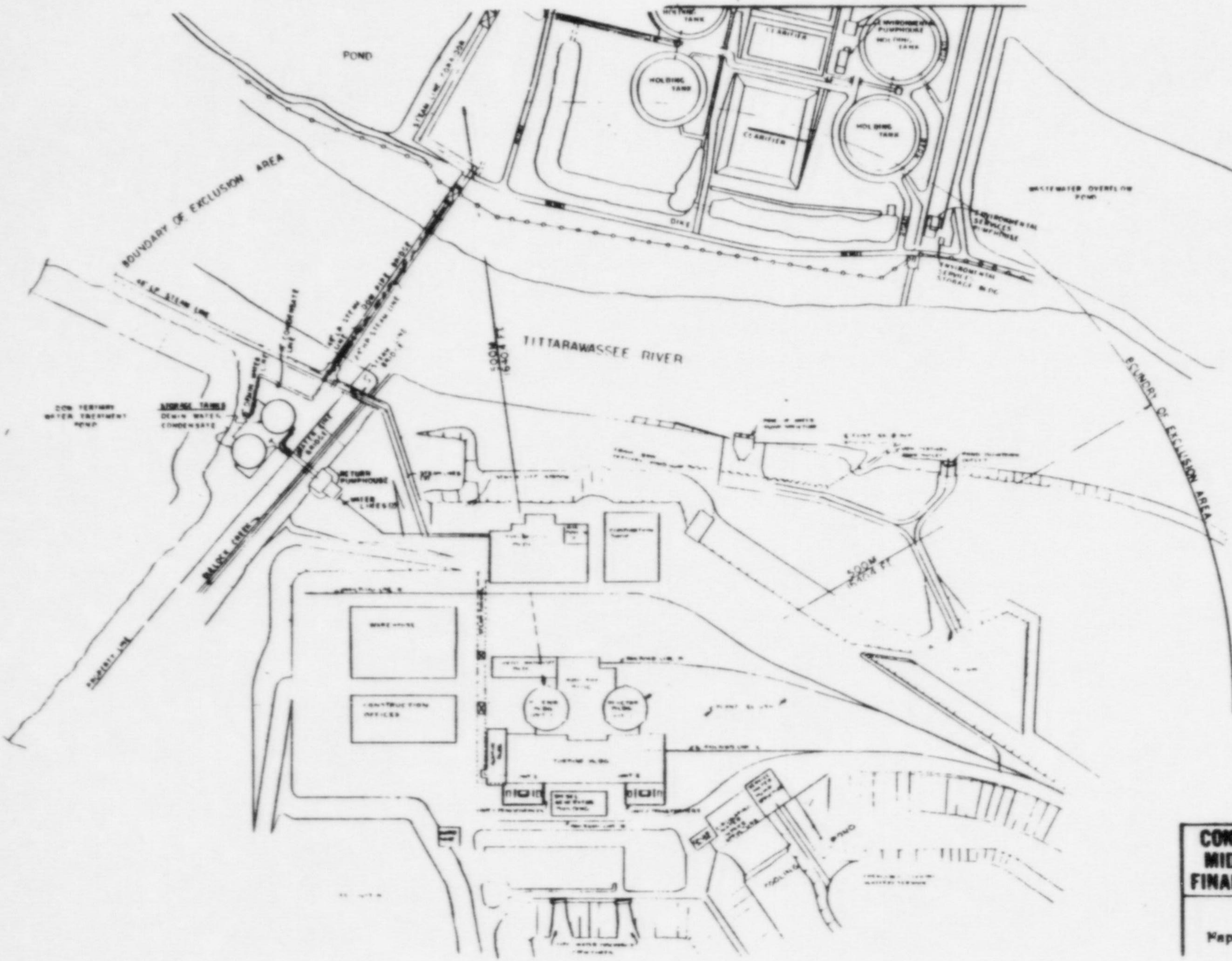
Midland Units 1 & 2 have a nominal finish grade elevation of +634 ft. The design high water level due to probable maximum flood, including wave run up effects is +635.5 ft. The design water level of the Tittabawassee River, cooling pond, and ultimate heat sink are +588 ft, +618 ft, and +604 ft, respectively.

ACRS REVIEW:

The ACRS reviewed Midland for a CP license in June 1970. A copy of the CP letter and supplement thereto is included as Attachments 3 & 4, respectively. The ACRS Midland Plant Subcommittee plans to review the application of Consumers Power Company for an OL on May 20&21, 1982 in Midland, MI. The full ACRS is tentatively scheduled to review the OL application during its June 1982 meeting.

SOILS ISSUES:

The April 29, 1982 ACRS Midland Plant Subcommittee meeting in Washington, DC is to discuss remedial actions being taken by Consumers Power Company regarding the Midland soils and structural settlement issues. The meeting is being conducted at the request of the NRC Staff (NRR). The NRC Staff and Consumers Power Compnay will provide information on these issues to the Subcommittee so that the ACRS might better comment on the merit of proposed and implemented fixes. A summary of the soils-related issues at the Midland Nuclear Plant is included in the attached reference material. I encourage you to read this executive summary first (transmitted by Consumers Power Company letter to H. Denton dated April 19, 1982). A list of other correspondences summarizing the soils-related issues at Midland is included as Attachment 5. The documents listed on Attachment 5 are appended to this meeting status report. A chronology regarding plant fill deficiencies was compiled by the NRC Staff's Project Manager for Midland. This chronology is included as Attachment 6. In view of the large volume of material being forwarded to you by this status report, I have arranged to have extra copies available at the meeting for your use.




CONSUMERS POWER COMPANY
MIDLAND PLANT UNITS 1 & 2
FINAL SAFETY ANALYSIS REPORT

Map of Midland Plants of the
Dow Chemical Company

TABLE 1.3-1

COMPARISON OF MIDLAND FEATURES WITH SIMILAR DESIGNS[(1)]

| System | Midland | Rancho Seco | Oconee | Turkey Point | |
|---|---|---|---|---|---|
| **Reactor and Reactor Coolant System (ref Chapters 4 and 5)** | | | | | |
| Rated heat output (core), MWt | 2,452 | 2,772 | 2,568 | 2,200 | |
| Maximum overpower, % | 12 | 12 | 14 | 12 | |
| Reactor coolant pressure (operating), psia | 2,200 | 2,200 | 2,200 | 2,250 | 1 / 32 |
| Power distribution factors | | | | | |
| Heat generated in fuel and cladding, % | 97.3 | 97.3 | 97.3 | 97.4 | |
| $F_{\Delta h}$ (nuclear) | 1.78 | 1.78 | 1.78 | 1.77 | |
| DNB ratio at rated conditions | 2.50 | 1.75(W-3) | 2.0 | 1.81 | |
| DNB ratio at design overpower | 2.07 | 1.39(W-3) | 1.55 | - | 32 |
| Coolant flow | | | | | |
| Total flowrate, lb/hr x $10^6$ | 131.3 | 137.8 | 131.3 | 101.5 | 16 |
| Effective flow area for heat transfer, ft² | 48.9 | 49.17 | 49.19 | 41.8 | 32 |
| Average velocity along fuel rods, ft/s | 15.5 | 16.5 | 15.73 | 14.3 | 32 |
| Coolant temperature | | | | | |
| Nominal inlet (vessel) | 555.2 | 556.5 | 554 | 546.2 | |
| Nominal outlet (vessel) | 602.8 | 607.7 | 604.7 | 602.1 | |
| Nominal outlet (core) | 605.9 | --- | 605.5 | 604.5 | 32 |
| Maximum fuel temperature, °F | 3,980 | 4,400(hotspot) | 4,250 | 4,400(overpower) | |
| Heat transfer at 100% power | | | | | |
| Active heat transfer surface area, ft² | 49,130 | 49,734 | 49,734 | 42,460 | |
| Average heat flux, Btu/hr/ft² | 166,000 | 185,090 | 171,470 | 171,600 | 32 |
| Average thermal output, kW/ft | 5.47 | 6.10 | 5.65 | 5.5 | |
| Core mechanical design parameters | | | | | |
| Fuel assemblies | 177 | 177 | 177 | 157 | |
| Design | CRA canless | CRA canless | CRA canless | RCC canless | |

(sheet 1)
Revision 32
1/81

ATTACHMENT 2

TABLE 1.3-1 (continued)

| System | Midland | Rancho Seco | Oconee | Turkey Point | |
|---|---|---|---|---|---|
| Rod pitch, in. | 0.568 | 0.568 | 0.568 | 0.563 | |
| Overall dimensions, in. | 8.587 sq | 8.536 sq | 8.536 sq | 8.426 sq | |
| Number of grids per assembly | 8 | 8 | 8 | 7 | |
| **Fuel rods** | | | | | |
| Number | 36,816 | 36,816 | 36,816 | 32,028 | |
| Outside diameter, in. | 0.430 | 0.430 | 0.430 | 0.422 | |
| Clad thickness, in. | 0.0265 | 0.0265 | 0.0265 | 0.0243 | |
| Clad material | Zircaloy-4 | Zircaloy-4 | Zircaloy-4 | Zircaloy | |
| **Fuel pellets** | | | | | |
| Material | $UO_2$, sintered | $UO_2$, sintered | $UO_2$, sintered | $UO_2$, sintered | |
| Density, % of theoretical | 95.0 | 92.5 | 93.5 | 94,93,92 | 33 |
| Diameter, in. | 0.3686 | 0.370 | 0.370 | 0.3659,0.3659,0.3649 | |
| **Control rod assemblies (CRA)** | | | | | |
| Neutron absorber | 5%Cd-15%In-80%Ag | 5%Cd-15%In-80%Ag | 5%Cd-15%In-80%Ag | 5%Cd-15%In-80%Ag | |
| Cladding material | 304SS-cold worked | 304SS-cold worked | 304SS-cold worked | 304SS-cold worked | |
| Clad thickness, in. | 0.021 | 0.021 | 0.021 | 0.019 | |
| Number of assemblies | 61 | 61 | 61 | 53 | |
| Number of control rods per assembly | 16 | 16 | 16 | 20 | |
| **Burnable poison rod assemblies (BPRA)** | 68 | 68 | 68 | 68 | |
| **Nuclear Design Data** | | | | | |
| **Structural characteristics** | | | | | |
| Fuel weight as $UO_2$, lb | 93.1 metric tons | 204,820 | 207,486 | 176,000 | |
| Core diameter, in. (equivalent) | 128.9 | 128.9 | 128.9 | 119.5 | |
| Core height, in. (active fuel) | 141.8 | 144 | 144 | 144 | 33 |
| **Performance characteristics** | | | | | |
| Loading technique | 3 region | 3 region | 3 region | 3 region | |
| Fuel discharge burnup, MWd/mtU | | | | | |
| average first cycle | 13,746 | 14,250 | 14,250 | 13,000 | 32 |
| equilibrium core average | 27,789 | --- | --- | 24,500 | |

TABLE 1.3-1 (continued)

| System | Midland | Rancho Seco | Oconee | Turkey Point |
|---|---|---|---|---|
| Control characteristics | | | | |
| Effective multiplication (BOL) | | | | |
| Cold, zero power, clean, no burnable poison | 1.24 | 1.252 | 1.248 | 1.180 |
| Hot, zero power, clean, no burnable poison | 1.19 | 1.19 | 1.198 | 1.138 |
| Hot, rated power, equilibrium Xe, with burnable poison | 1.11 | 1.12 | 1.134 | 1.077 |
| Boron concentrations | | | | |
| To shutdown with rods inserted, clean, cold/hot, ppm | 1,143/641 | 1,099/605 | 992/493 | 780/510 |
| Boron worth, hot, %(Δk/k)/ppm | 1/96 | 1/100 | 1/100 | 7.3/--- |
| Boron worth, cold, %(Δk/k)/ppm | 1/74 | 1/75 | 1/75 | 5.6/--- |
| Principal design parameters of the reactor coolant system | | | | |
| System heat output, MWt | 2,468 | 2,772 | 2,584 | 2,200 |
| Operating pressure, psig | 2,185 | 2,185 | 2,185 | 2,235 |
| Reactor inlet temperature, °F | 555.2 | 556.5 | 554 | 546.2 |
| Reactor outlet temperature, °F | 602.8 | 607.7 | 604 | 602.1 |
| Number of loops | 2 | 2 | 2 | 3 |
| Design pressure, psig | 2,500 | 2,500 | 2,500 | 2,485 |
| Design temperature, °F | 650 | 650 | 650 | 650 |
| Hydro test pressure (cold), psig | 3,125 | 3,125 | 3,125 | 3,107 |
| Principal design parameters of reactor vessel | | | | |
| Material | SA-533 Gr B, 18-8SS clad | SA-533, Gr B 18-8SS clad | SA-533, Gr B, 18-8SS clad | SA-302 Gr B, low alloy steel, internally clad with SS |
| Design pressure, psig | 2,500 | 2,500 | 2,500 | 2,485 |
| Design temperature, °F | 650 | 650 | 650 | 650 |
| Operating pressure, psig | 2,185 | 2,185 | 2,185 | 2,235 |
| Inside diameter of shell, in. | 171 | 171 | 171 | 155.5 |
| Overall height of vessel and closure head (over CRD nozzles), ft-in. | 40/8-7/8 | 40/8-3/4 | 40/8-3/4 | 41/6 |

TABLE 1.3-1 (continued)

| System | Midland | Rancho Seco | Oconee | Turkey Point |
|---|---|---|---|---|
| Minimum clad thickness, in. | 1/8 | 1/8 | 1/8 | 5/32 |
| Principal design parameters of the steam generators | | | | |
| Number of units per reactor | 2 | 2 | 2 | 3 |
| Type | Vertical, once-through, integral superheater, straight-tube | Vertical, once-through, integral superheater, straight-tube | Vertical, once-through, integral superheater, straight-tube | Vertical U-tube, integral moisture separator |
| Tubeside design pressure, psig | 2,500 | 2,500 | 2,500 | 2,485 |
| Tubeside design temperature, °F | 650 | 650 | 650 | 650 |
| Shell side design pressure, psig | 1,050 | 1,050 | 1,050 | 1,085 |
| Shell side design temperature, °F | 600 | 600 | 600 | 556 |
| Operating pressure | | | | |
| Tubeside, psig | 2,185 | 2,185 | 2,185 | 2,235 |
| Shell side, psig | 910 | 910 | 910 | 1,020 |
| Hydrostatic test pressure, cold, tubeside, psig | 3,125 | 3,125 | 3,125 | 3,107 |
| Principal design parameters of reactor coolant pumps | | | | |
| Number of pumps | 4 | 4 | 4 | 3 |
| Type | Vertical, single stage | Vertical, single stage | Vertical, single stage | Vertical, single stage |
| Design pressure, psig | 2,500 | 2,500 | 2,500 | 2,485 |
| Design temperature, °F | 650 | 650 | 650 | 650 |
| Design capacity, gpm | 88,000 | 92,400 | 88,000 | 89,500 |
| Design total developed head, ft | 327 | 362 | 396 | 260 |
| Hydrostatic test pressure (cold), psig | 3,125 | --- | --- | 3,107 |
| Motor type | ac, induction, single speed | ac, induction, single speed | ac, induction, single speed | ac, induction, single speed |
| Motor rating, hp | 9,000 | 10,000 | 9,000 | 6,000 |
| Reactor coolant piping | | | | |
| Hot leg (id.) in. | 36 | 36 | 36 | 29 |
| Cold leg (id.) in. | 28 | 28 | 28 | 27-1/2 |

TABLE 1.3-1 (continued)

| System | Midland | Rancho Seco | Oconee | Turkey Point | |
|---|---|---|---|---|---|
| **Engineered Safety Features (ref Chapter 6)** | | | | | |
| Safety injection system | | | | | |
| Number of high head pumps | 3 | 3 | 3 | 4 (shared) | |
| Capacity each, gpm/ft | 250/6,000 | 300/5,850 | 250/5,900 | 300/2,700 | 15 |
| Number of low head pumps | 2 | 2 | 2 | 2 | |
| Capacity each, gpm/ft | 3,000/370 | 3,000/350 | 3,000/350 | 3,750/240 | |
| Containment coolers | | | | | |
| Type | Fan coolers | Fan coolers | Fan coolers | Fan coolers | |
| Number of units | 4 | 4 | 3 | 3 | |
| Capacity, Btu/hr each, at accident | $50\times10^6$ | $60\times10^6$ | $80\times10^6$ | $60\times10^6$ | |
| Core flooding system | | | | | |
| Number of tanks | 2 | 2 | 2 | 3 | |
| Total water volume, each $ft^3$ | 1,040 | 1,040 | 1,040 | 1,200 (total volume) 775 water vol min | |
| Containment spray | | | | | |
| Number of pumps | 2 | 2 | 2 | 2 | |
| Capacity, each, gpm | 1,300 | 1,500 | 1,500 | 1,450 | 13 |
| Spray additive for iodine removal | $N_2H_4$ | NaOH | None | None | |
| Emergency power | | | | | |
| Type | Diesel | Diesel | Various | Diesel | |
| Quantity | 2/5,250kW each continuous | 2/2,600kW each continuous | 7 sources of significant capacity | 2/2,500kW each continuous | |
| **Power Conversion System (ref Chapter 10)(1)** | | | | | |
| Turbine-generator | Unit 2 / Unit 1 | | | | |
| Gross generator output, MW | Unit 2: 852; Unit 1: 504.8,(2) 595.2(3) | 850 | 847 | 728 | 1 |
| Cylinders, high-pressure, low-pressure | Unit 2: 1 hp, 2 lp; Unit 1: 1 hp, 1 lp | 1 hp, 2 lp | 1 hp, 3 lp | 1 hp, 3 lp | |

TABLE 1.3-1 (continued)

| System | Midland | | Rancho Seco | Oconee | Turkey Point |
|---|---|---|---|---|---|
| **Steam conditions at throttle valve** | | | | | |
| Flow, $10^6$ lb/hr | 9.77 | 9.62 | 10.77 | 11.17 | 8.97 |
| Pressure, psia | 900 | 900 | 900 | 900 | 745 |
| Temperature, °F | 566.4 | 566.4 | 595 | 568.8 | 510 |
| Moisture content, % | 0 | 0 | 0 | 0 | 0.25 |
| **Steam flow to Dow Chemical** | | | | | |
| Pressure, psig hp/lp | -/- | 632/198(4) | - | - | - |
| Flow, lb/hr hp/lp | -/- | 800,000/$3.65x10^6$(2) | - | - | - |
| | -/- | $6.84x10^5$/$1.8x10^6$(3) | | | |
| **Turbine cycle arrangement** | | | | | |
| Steam reheat stages, no. | 2 | 2 | 2 | 2 | 1 |
| Feedwater heating stages, no. | 5 | 5 | 6 | 6 | 6 |
| Strings of feedwater heaters, no. | 2 | 2 | 2 | 2 | 2 |
| **Heaters in condenser necks, number** | 2 | 2 | 0 | 1 | 2 |
| Heater drain system | Deaerator cycle | Deaerator cycle | Cascade | Pumped forward | Pumped forward |
| Number of condensate pumps | 2 | 2 | 3 | 3 | 2 |
| Number of condensate booster pumps | 2 | 2 | 0 | 3 | 0 |
| Number of main feedwater pumps | 2 | 2 | 2 | 2 | 2 |
| Number of auxiliary feedwater pumps | 2<br>1-turbine<br>1-motor | 2<br>1-turbine<br>1-motor | 2<br>1-turbine<br>1-motor | 1 with interties to other 2 units - turbine driven | 3-turbine |
| Capacity, each, gpm | 885 | 885 | 840 | 7-1/2% full feedwater capacity | 600 |

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TABLE 1.3-1 (continued)

| System | Midland | | Rancho Seco | Oconee | Turkey Point |
|---|---|---|---|---|---|
| Main steam turbine bypass capacity, % | 15% | 15% | 15% | 25% | 40% |
| Final feedwater temperature °F at mgl | 430 | 430 | 471 | 460 | 436 |
| Condenser | | | | | |
| Type | Dual pressure | Single pressure | Dual pressure | - | Single pressure |
| Condenser shells | 2 | 1 | 2 | - | 2 |
| Design pressure Hg abs hp/lp | 4.07/2.77 | 2.83 | 2.5 average | - | 2.5 |
| Total condenser duty, Btu/hrx$10^{9}$ | 5.51 | 2.14 | 6.24 | - | 5.02 |
| Circulating water system | Cooling pond | Cooling pond | Cooling tower (hyperbolic) | Once through Lake Keowee | Once through Biscayne Bay |
| Circulating water pumps | 2/Unit 2 | 2/Unit 1 | 4/Unit | 4/Unit | 2/Unit |
| Flow, gpm x $10^{5}$/unit | 2.64 | 3.90 | 4.47 | 7.08 | 3.12 |
| Ultimate heat sink | Cooling pond | Cooling pond | Spray pond | Lake Keowee | Biscayne Bay |
| Service water pumps, no. | 2/Unit 2 (Plus one spare for Units 1&2) | 2/Unit 1 common | 2/Unit | 3 shared | 3 shared |
| Flow, gpm/each pump | 21,000 | 21,000 | 16,000 | 15,000 | 16,000 |
| Radioactive Waste Management Systems (ref Chapter 11) | | | | | \| 32 |
| Liquid radwaste treatment | Degasified, filtered, demineralized, evaporated | | Degasified, filtered, demineralized, evaporated | Degasified, evaporated | Degasified, demineralized evaporated |

TABLE 1.3-1 (continued)

| System | Midland | Rancho Seco | Oconee | Turkey Point |
|---|---|---|---|---|
| Evaporators, waste capacity, gpm | 30 | 30 | 10 approx | 20 |
| Quantity | 1 | 1 | 1 | 1 |
| Demineralizers, waste capacity, gpm | 150 | 150 | None | 1,000 gal. batch @ 2 gpm |
| Quantity | 2 | 2 | - | 1 |
| Gaseous radwaste treatment | Holdup tanks for decay, charcoal, and HEPA filters | Holdup tanks for decay, charcoal, and HEPA filters | Holdup tanks for decay, prefilter, absolute, and charcoal filters | Holdup tanks for decay, monitored, released to atmosphere |
| Holdup Tanks | | | | |
| Quantity | 6 | 4 | 2 | 6 |
| Capacity, cubic ft (each) | 390 | 490 | 1,100 | 525 |
| Solid radwaste treatment | | | | |
| Containers | 55 gallon drum | 55 gallon drum | 55 gallon drum | 55 gallon drum |
| Containment (ref Subsection 6.2.1 | | | | |
| Type | Steel lined, prestressed, post-tensioned concrete cylinder with curved dome roof | Steel lined, prestressed, post-tensioned concrete cylinder with curved dome roof | Steel lined, prestressed, post-tensioned concrete cylinder with curved dome roof | Steel lined, prestressed, post-tensioned concrete cylinder with curved dome roof |
| Leak rate, %/day | 0.1 | 0.1 | 0.25 | 0.25 |
| Design pressure, psig | 70 | 59 | 59 | 49.9 \| 32 |
| Free volume, $ft^3 x 10^6$ | 1.67 | 1.98 | 1.91 | 1.55 |
| Cylinder inner diameter, ft | 116 | 130 | 116 | 116 |
| Inside height, ft | 193 | 185 | 208-1/2 | 169 |

TABLE 1.3-1 (continued)

| System | Midland | Rancho Seco | Oconee | Turkey Point |
|---|---|---|---|---|
| **Structural Design Requirements (ref Section 3.8)** | | | | |
| Operating basis earthquake (horiz g) | .06 | 0.13 | 0.05 | 0.05 |
| Safe shutdown earthquake (horiz g) | .12 | 0.25 | 0.10 | 0.15 |
| Vertical seismic ground motion (% of horizontal) | 67 | 68 | - | 66 |
| Maximum sustained wind, mph | 85 | 90 | 95 | 145 |
| Tornadoes, mph | 360 max | - | 300 | 225 |
| **Electrical Systems (ref Chapter 8)[4]** | | | | |
| Number of offsite circuits | 2 | 5 | 12 | (4 from 2 nuc units, 3 from fossil fuel) |
| Number of auxiliary power sources | 2-startup transformers (shared)<br>2-unit aux transformers | 2-startup transformers<br>1-unit aux transformer | 1-startup transformer<br>1-unit aux transformer | 1-startup transformer<br>1-unit aux transformer |
| Number of preferred power to ESF buses | 2 | 2 | - | 2 |
| Number of 4.16kV ESF buses/unit (4kV) | 2 | 2 | 3 | 2 |
| Number of Class 1E 125Vdc systems supplying buses/unit | 2 | 4 | 2 | 2 |
| Number of Class 1E 120Vac preferred buses/unit | 4 | 4 | 4 | 4 |
| Sharing of standby power | none | none | none | none |
| **Fuel Handling Equipment and Facilities (ref Section 9.1)** | | | | |
| Reactor building crane | | | | |
| Type | polar | polar | polar | polar |
| Capacity, tons | 190 main, 25 aux | 180 | - | 135 main, 35 aux |

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TABLE 1.3-1 (continued)

| System | Midland | Rancho Seco | Oconee | Turkey Point | |
|---|---|---|---|---|---|
| Transfer tubes/unit | | | | | |
| Number | 1 | 2 | 2 | 1 | |
| Capacity | dual | dual | dual | single | |
| Spent fuel storage | | | | | |
| Capacity (number of fuel assemblies) | 1,049 | 242 | 336 | 217 | 15 |
| New fuel storage | | | | | |
| Type | | | | | |
| Wet or dry storage | Dry | Dry | Wet | Wet | |
| Capacity/unit | 66 | 20 | 168 (new & spent) | 53 | 32 |
| Cask handling crane | | | | | |
| Type | Double girder bridge | Gantry crane | Double girder bridge | Double girder bridge and trolley | |
| Capacity, tons | 125 main, 15 aux | 185 main, 35 aux<br>cask weight = 100 | 100 | 105 main, 15 auxiliary | |

(1)Midland data given for Unit 2, unless Unit 1 data given in addition. All data for other plants given on per unit basis.
(2)Design steam flow to Dow at rated reactor power. High-pressure process steam flow may exceed 400,000 lb/hr, up to a maximum of 800,000 lb/hr, when low-pressure process steam production is less than 3,650,000 lb/hr. 32
(3)Based on maximum calculated electrical production at 2,468MWt with a minimum corresponding steam flow to Dow.
(4)Represents total incoming and outgoing circuits.
(5)Data on plants other than Midland not maintained current after August 1977. 32

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# ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

UNITED STATES ATOMIC ENERGY COMMISSION

WASHINGTON, D.C. 20545

June 18, 1970

Honorable Glenn T. Seaborg
Chairman
U. S. Atomic Energy Commission
Washington, D. C. 20545

Subject: REPORT ON MIDLAND PLANT UNITS 1 & 2

Dear Dr. Seaborg:

During its 122nd meeting, June 11-13, 1970, the Advisory Committee on Reactor Safeguards completed its review of the application by the Consumers Power Company for a permit to construct the Midland Plant Units 1 and 2. During this review, the project also was considered at Subcommittee meetings held on January 22, 1969, at the plant site, on April 24, 1970, at Chicago, Illinois, on February 4, 1969, March 24, 1970, and June 10, 1970, at Washington, D. C. and at the ACRS meetings of February 6, 1969, April 9, and May 8, 1970, in Washington, D. C. In the course of these meetings, the Committee had the benefit of discussions with representatives and consultants of the Consumers Power Company, Babcock and Wilcox Company, Bechtel Corporation, Dow Chemical Company, and the AEC Regulatory Staff. The Committee also had the benefit of the documents listed.

The Midland Plant site is on the south bank of the Tittabawassee River adjacent to the southern city limits of Midland, Michigan. The main industrial complex of the Dow Chemical Company lies within the city limits directly across the river from the site and provides an area of controlled access about two miles wide between the reactor site and the Midland business and residential districts. The exclusion area of the plant site has a radius of 0.31 miles and includes a small segment of the Dow plant; no Dow employees are permanently assigned in this segment, and the applicant has the right to remove any persons from this segment if conditions warrant. The low population zone has a radius of 1.0 miles and contains 38 permanent residents and about 2,000 industrial workers, mainly employees of Dow Chemical Company. The number of permanent residents within five miles of the plant site was estimated to be 41,000 in 1968, mainly in the city of Midland and its environs.

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ATTACHMENT 3

The applicant has established criteria for, and has begun the formulation of a comprehensive emergency evacuation plan. This plan is being coordinated with the well-established plan of the Dow Chemical Company for emergency evacuation of the Midland chemical plant and portions of the City of Midland in case of major emergencies at the chemical plant. Close coordination with appropriate municipal and state authorities is also being established.

The Midland units will each include a two-loop pressurized water reactor designed for initial core power levels up to 2452 MWt. The nuclear steam supply systems and the emergency core cooling systems of these units are essentially identical with those for the previously reviewed Oconee Units 1, 2 and 3 and Rancho Seco Unit 1 (ACRS reports of July 11, 1967 and July 19, 1968, respectively). The combined electrical output of the two units will be 1300 MW. In addition, 4,050,000 lbs per hour of secondary steam will be exported to the adjacent Dow plant to supply thermal energy for chemical processing operations.

The prestressed, post-tensioned concrete reactor containment buildings are similar to those approved for the Oconee Units 1, 2 and 3. The design will include penetrations, which can be pressurized, and isolation valve seal water systems to reduce leakage. Channels will be welded over the seam welds of the containment liner plates to permit leak testing of the seam welds.

Cooling water for the Midland reactors is supplied from a diked pond with a capacity of 12,600 acre-feet. Make-up water is taken from the Tittabawassee River. The cooling water supply is sufficient for 100 days of full power operation without make-up during periods of low river flow. In the unlikely event of a gross leak through the dikes of the cooling pond, a supplemental source of water will be available. The supplemental source is provided within the main pond by excavating a 24 acre area to a depth of six feet below the bottom of the main pond. This source can supply shut-down cooling capability for 30 days without make-up.

The applicant will conduct an on-site meteorological monitoring program to verify the applicability of the meteorological models used for accident evaluation and routine release limits as well as to determine any meteorological effect of the cooling pond. This program should be completed during construction.

Midland is the first duel purpose reactor plant to be licensed for construction. The export steam originates from the secondary side of the steam generators and may contain traces of radioactive leakage from the primary system. The demineralized condensate from 60 to 75 percent of the export steam is returned by Dow to the feed water supply of the reactor plant. The condensate from the remaining steam is either chemically contaminated or cannot practically be returned to the nuclear plant. It is collected in the Dow waste treatment system for dilution and processing with other streams before eventual discharge to the river. Thus, the unreturned portion of the condensate represents an effluent from the reactor plant to which the requirements of 10 CFR Part 20 must apply.

This matter may be considered in two parts: (1) the steps taken by the applicant to ensure that any radioactivity in the export steam is within the limits set by 10 CFR Part 20 and as low as practicable and (2) the measures taken by the Dow Chemical Company to ensure that the export steam can be used in chemical operations without product contamination and that the unreturned steam condensate is properly managed for safe disposal. In connection with item (1), the applicant proposes to monitor and control radioactivity in the export steam. A representative, continuous sample of the export steam will be condensed for monitoring and laboratory analysis. The gamma activity of this flowing sample will be continuously monitored by on-line analyzers and an alarm actuated if the activity exceeds an appropriate limiting value. The alarm will serve to indicate any change in the integrity of the steam generators or fuel cladding. Samples of this condensate stream will be analyzed at appropriate intervals by sensitive low-level beta counting for determination of gross beta activity and concentration of selected radionuclides. The applicant agrees to limit, by maintaining high integrity of the steam generators and fuel cladding, the yearly average gross beta activity in the export steam to one-tenth or less of the limits specified by 10 CFR Part 20 for the selected radionuclides. The yearly average will include any periods of short duration when the concentrations may approach but not exceed the 10 CFR Part 20 limits. The applicant states that in his judgment it is practical to operate the plant within these limits. If these limits are exceeded, corrective measures will be taken in the plant or the delivery of export steam to Dow will be terminated. He also agrees to demonstrate the analytical equipment and procedures in development programs to be carried forward and completed during construction of the Midland Plant. In connection with item (2), Dow has stated that they will apply for a 10 CFR Part 30 Materials License to receive, possess, and use the export (secondary) steam as a source of thermal and mechanical energy. No export steam or condensate will be intentionally introduced into any product. Isolation of the export steam from contact with products will be accomplished by the use of heat exchange devices which will provide suitable physical barriers. Programs will be established to provide for detection of leaks in the heat exchange devices by analyses, monitors, and other means; for repair of leaks when detected; and for appropriate administrative control of the programs.

Dow has stated that accumulation of radioactivity from the export steam and release of radioactive materials in the effluent will be in accordance with 10 CFR Part 20. The unreturned condensate will represent less than 10% of the total liquid effluent disposed of through the Dow waste treatment plant and the annual average concentration in the total effluent is expected to be less than 1% of the 10 CFR Part 20 limits.

The Committee believes that the criteria proposed by the applicant and Dow for the control of radioactivity in the export steam are necessary and adequate. The detailed procedures for implementation should be developed during construction in a manner satisfactory to the Regulatory Staff. The Committee wishes to be kept informed.

To minimize the likelihood of subsidence at the site, the applicant and Dow have agreed to prohibit future salt mining operations within one-half mile from the center of the reactor plant. No new wells will be drilled within this distance and all existing wells will be abandoned and plugged. The Committee believes these arrangements are satisfactory.

A large volume of liquid chlorine is maintained in a refrigerated storage vessel about one mile from the Midland plant control room. The applicant is continuing his study of the consequences of a major accidental release of chlorine from this vessel. He has included in his criteria for the design of the control room the objective of finding a practical method of maintaining the concentration of chlorine in the control room atmosphere below the eight hour threshold limiting value (TLV) of 1 ppm for the most serious conceivable chlorine accident. The Committee believes that adequate air purification facilities should be provided in the control room ventilation system to reduce chlorine concentration to the eight hour TLV of 1 ppm so that operators can work without respiratory equipment during an extended chlorine emergency. This matter should be resolved during construction in a manner satisfactory to the Regulatory Staff.

The reactor vessel cavity will be designed to withstand mechanical forces and pressure transients comparable to those considered in the design of the Zion and Indian Point-3 plants.

The applicant has stated that he will provide additional evidence obtained by improved multi-node analytical techniques to assure that the emergency core cooling system is capable of limiting core temperatures to the limits established at present. He will also make appropriate plant changes if the further analysis demonstrates that such changes are required. This matter should be resolved during construction in a manner satisfactory to the Regulatory Staff. The Committee wishes to be kept informed.

The safety injection system for the Midland plant is actuated by either low reactor pressure or high containment pressure signals. However, of these two, the reactor is tripped only by the low reactor pressure signal. The Committee believes that provision also should be made to trip the reactor by the high containment pressure signal.

The applicant plans to develop more detailed criteria for the installation of protection and emergency power systems together with appropriate procedures to maintain the physical and electrical independence of the redundant portions of these systems. The Committee believes that these criteria and procedures should be reviewed and approved by the Staff prior to actual installation.

The applicant considers the possibility of melting and subsequent disintegration of a portion of a fuel assembly because of flow starvation, gross enrichment error, or from other causes to be remote. However, the resulting effects in terms of local high temperature or pressure and possible initiation of failure in adjacent fuel elements are not well known. Appropriate studies should be made to show that such an incident will not lead to unacceptable conditions.

The Committee believes that consideration should be given to the utilization of instrumentation for prompt detection of gross failure of a fuel element.

The Committee has commented in previous reports on the development of systems to control the buildup of hydrogen in the containment which might follow in the unlikely event of a major accident. The applicant proposes to make use of a technique of purging through filters after a suitable time delay subsequent to the accident. However, the Committee recommends that the primary protection in this regard should utilize a hydrogen control method which keeps the hydrogen concentration within safe limits by means other than purging. The capability for purging should also be provided. The hydrogen control system and provisions for containment atmosphere mixing and sampling should have redundancy and instrumentation suitable for an engineered safety feature. The Committee wishes to be kept informed of the resolution of this matter.

The Committee recommends that the applicant accelerate the study of means of preventing common failure modes from negating scram action and of design features to make tolerable the consequences of failure to scram during anticipated transients. The applicant stated that the engineering design would maintain flexibility with regard to relief capacity of the primary system and to a diverse means of reducing reactivity. This matter should be resolved in a manner satisfactory to the Regulatory Staff during construction. The Committee wishes to be kept informed.

Other problems related to large water reactors have been identified by the Regulatory Staff and the ACRS and cited in previous ACRS reports. The Committee believes that resolution of these items should apply equally to the Midland Plant Units 1 & 2.

The Committee believes that the above items can be resolved during construction and that, if due consideration is given to these items, the

nuclear units proposed for the Midland Plant can be constructed with reasonable assurance that they can be operated without undue risk to the health and safety of the public.

Sincerely yours,

/s/
Joseph M. Hendrie
Chairman

References

1) Amendments 1 - 12 to License Application