BALTIMORE GAS AND ELECTRIC COMPANY

P. O. BOX 1475
BALTIMORE, MARYLAND 21203

January 29, 1980

ARTHUR E. LUNDVALL, JR.
VICE PRESIDENT
SUPPLY

Office of Nuclear Reactor Regulation
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

Attn: Mr. Brian K. Grimes, Director
Emergency Preparedness Task Group

Subject: Calvert Cliffs Nuclear Power Plant
Units Nos. 1 & 2, Dockets Nos. 50-317 & 50-318
Evacuation Time Estimates

Reference: NRC letter dated 11/29/79 from B. K. Grimes to
All Power Reactor Licensees, same subject.

Gentlemen:

Attached is the information requested by the referenced letter.

Very truly yours,

for A. E. Lundvall, Jr.

1865 345

cc: J. A. Biddison, Esquire
G. F. Trowbridge, Esquire
Mr. E. L. Connrer, Jr.

Calvert County Library
Prince Frederick, MD 20678

Director, Department of State Planning
301 West Preston Street
Baltimore, MD 21201

Mr. Bernard Fowler, President
Board of County Commissioners
Prince Frederick, MD 20768

Director, Technical Assessment Division
Office of Radiation Programs (AW-459)
U. S. Environmental Protection Agency
Crystal Mall #2
Arlington, VA 20460

U. S. Environmental Protection Agency
Region III Office
Attn: EIS Coordinator
Curtis Building (Sixth Flr)
Sixth and Walnut Streets
Philadelphia, PA 19106

Administrator, Power Plant Siting
Program
Energy and Coastal Zone Administration
Department of Natural Resources
Tawes State Office Building
Annapolis, MD 21401

8002040 490

Calvert Cliffs Nuclear Power Plant
EPZ Evacuation Times

Introduction: In an effort to determine estimated evacuation times for various areas around the Calvert Cliffs Nuclear Power Plant, as detailed by the November 29, 1979 letter from the NRC, the Baltimore Gas and Electric Co. has decided to employ the Houston Evacuation Model. This model involves the calculations referenced in the prepared testimony of R. W. Houston on behalf of the NRC in the matter of Northern States Power Co., Tyrone Energy Park, Unit 1, Eau Claire, Wisconsin, October 7, 1976. The evacuation times calculated herein are strict applications of this model made site-specific to the Calvert Cliffs Nuclear Power Plant by using current population distribution data.

I. Calculations

$$\text{Time (hrs.)} = \frac{1.05\, A^{0.27}\, N^{0.23}}{L^{0.5}}$$

Where A = Area in sq. miles
N = Number of people evacuating (population)
L = Number of routes to be used in evacuation.

And $L = \frac{1}{2}\, r \sqrt{A}$

Time = Warning and evacuation Time
where $r = 0.261\ (p)^{-0.403}$
Where p = population density

TABLE 1

Section	Area (sq. mi.)	N	p	r	L	$L^{0.5}$	Time (hrs.)
N (0-2 mi.)	6.3	137	22	1.0	1.2	1.1	4.8
S (0-2 mi.)	6.3	773	123	2.0	2.4	1.6	5.0
NW (2-5 mi.)	16.5	2192	133	2.0	4.1	2.0	6.6
SW (2-5 mi.)	16.5	1491	90	1.7	3.4	1.9	6.3
NE (2-5 mi.)	16.5	0	0	---	---	---	---
SE (2-5 mi.)	16.5	934	57	1.4	2.8	1.7	6.4
NW (5-10mi.)	58.9	4903	83	1.7	6.5	2.6	8.6
SW (5-10mi.)	58.9	6363	108	1.8	6.9	2.6	9.1
SE (5-10mi.)	58.9	10,260	174	2.2	8.4	2.9	9.1
NE (5-10mi.)	58.9	601	10	0.7	2.7	1.6	8.6

Since prompt notification systems have not been fully installed in the 10 mile radius to the Calvert Cliffs Nuclear Power Plant, it is expected that initial warning could be given to all people within the 0-2 mi. sections in 15 minutes. Similar notification may take 30 minutes in the 2-5 mile sections and 1 hour in the 5-10 mile sections. This would yield the following (shown graphically in Appendix A):

TABLE 2

Section	Estimated Warning & Evacuation Time (hrs)	Estimated Warning (hrs)	Evacuation Time (hrs)	NRC Evacuation Time (hrs)*
N (0-2 mi.)	4.8	.25	4.6	4.6
S (0-2 mi.)	5.0	.25	4.8	4.8
NW (2-5 mi.)	6.6	.5	6.1	6.4
SW (2-5 mi.)	6.3	.5	5.8	6.0
NE (2-5 mi.)	---	---	---	---
SE (2-5 mi.)	6.4	.5	5.9	6.2
NW (5-10mi.)	8.6	1.0	7.6	8.4
SW (5-10mi.)	9.1	1.0	8.1	8.8
SE (5-10mi.)	9.1	1.0	8.1	8.8
NE (5-10mi.)	8.6	1.0	7.6	8.4

*Includes all estimated warning times greater than 15 minutes.

Because an adverse weather scenario is too highly subjective to use as a planning guide, it is expected that each episode of a warning/evacuation maneuver may take twice as long, given adverse weather condition. This would yield the following (shown graphically in Appendix A):

TABLE 3

Section	Estimated Warning & Evacuation Time (hrs)	Estimated Warning (hrs)	Evacuation Time (hrs)	NRC Evacuation Time (hrs)*
N (0-2 mi.)	9.6	.5	9.1	9.4
S (0-2 mi.)	10.0	.5	9.5	9.8
NW (2-5 mi.)	13.2	1.0	12.2	13.0
SW (2-5 mi.)	12.6	1.0	11.6	12.4
NE (2-5 mi.)	----	---	----	----
SE (2-5 mi.)	12.8	1.0	11.8	12.6
NW (5-10mi.)	17.2	2.0	15.2	17.0
SW (5-10mi.)	18.2	2.0	16.2	18.0
SE (5-10mi.)	18.2	2.0	16.2	18.0
NE (5-10mi.)	17.2	2.0	15.2	17.0

*Includes all estimated warning times greater than 15 minutes.

II. Special Facilities

No special facilities have been identified in any of the above EPZ sections that could not be evacuated by the normal procedures and within the times previously specified. Special facilities may include fire/rescue halls, movie theaters, or country club facilities. No hospitals are within the 10 mile radius of the Calvert Cliffs Nuclear Power Plant.

III. Evacuation Confirmation

It is felt that, if special instructions are given to the public along with evacuation information, the confirmation of evacuation could be completed within the same time frame allotted for warning. Warning and confirmation are similar functions encompassing identical areas; therefore, equal time is estimated for both.

IV. Special Evacuation Problems

No special evacuation problems, requiring alternative protective actions, have been identified within the 10 mile radius surrounding the Calvert Cliffs Nuclear Power Plant.

V. Background Information

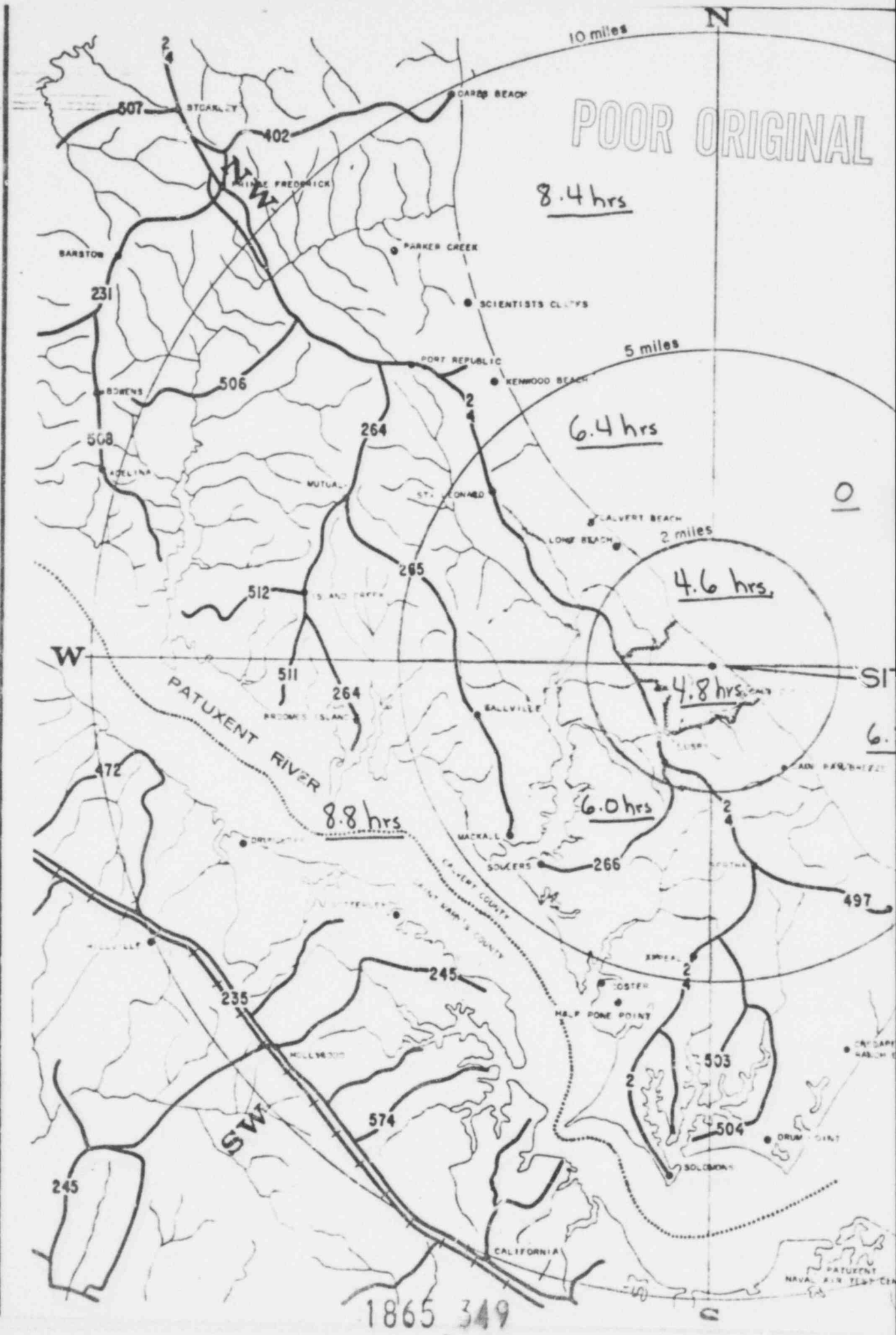
1. The model used for evacuation and warning time estimates was the R. W. Houston (prepared on behalf of the NRC) Model. The model was based, in part, on information contained in EPA-520/6-74-002, "Evacuation Risk - an Evaluation"; which presents an evaluation of actual evacuation incidents.

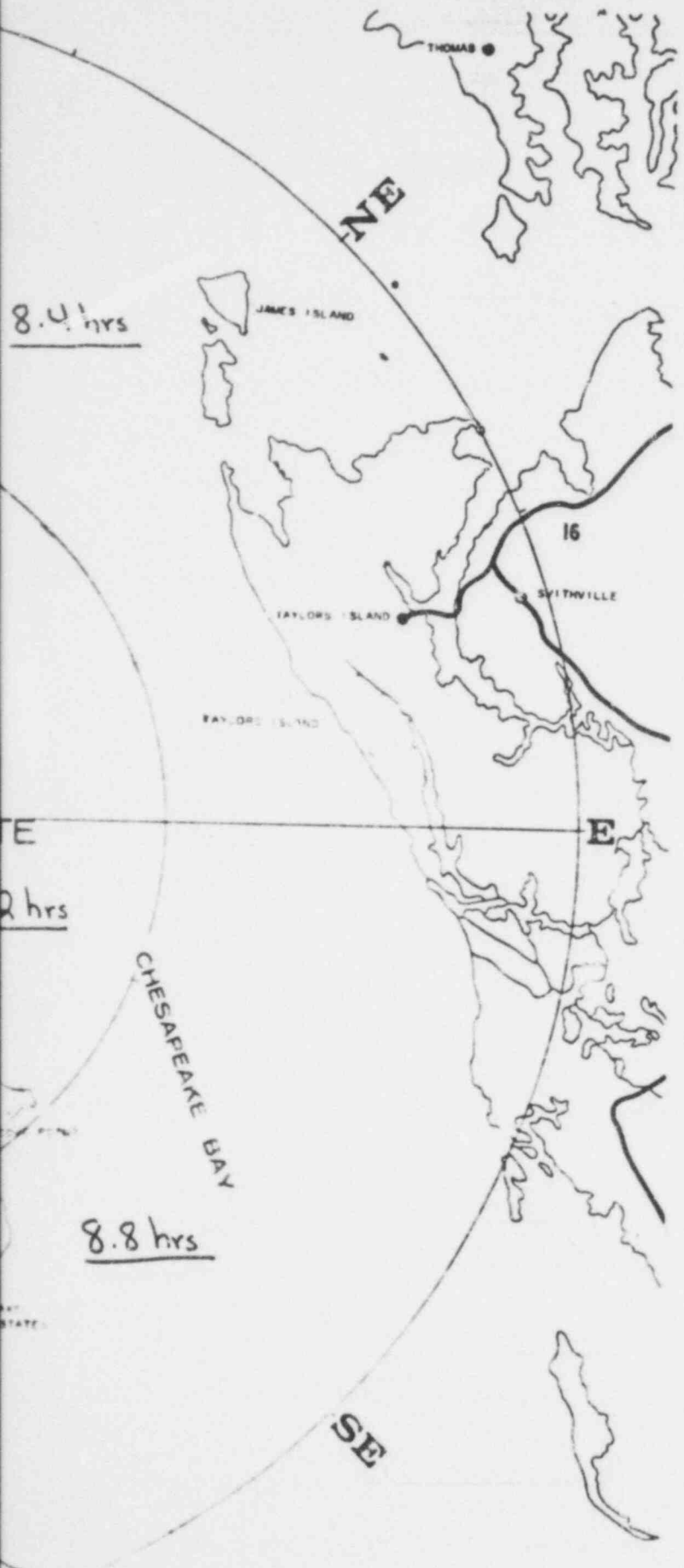
2. The population and population distribution figures used for the 10 mile radius surrounding the Calvert Cliffs Plant were extropolated from data obtained in the Final Safety Analysis Report (FSAR). The FSAR contains 1970 population estimates and a projected population estimate for 2010. The population figures used herein are based on a linear population growth between these years; in lieu of actual population data. These are presented as conservative estimates.

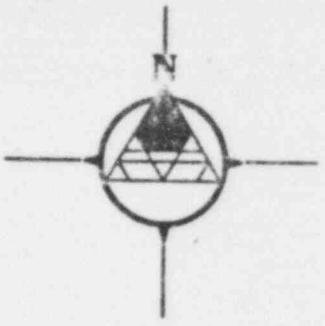
3. It is assumed that all evacuees will provide their own transportation, or carpool with a neighbor, wherever possible. Local officials will work with local bus companies or the Departments of Education to evacuate schools and those without personal vehicles.

4. Evacuation routes will depend on the areas to be evacuated and the radioactive plume coverage. The County Sheriffs' Departments and the Maryland State Police, in conjunction with the local Civil Defense Agency, will determine evacuation routes to be used.

5. Attachments 1, 2 and 3 are letters from the officials of the 3 EPZ Counties surrounding the Calvert Cliffs Nuclear Power Plant expressing their views of these evacuation estimates.


N
10 miles
5 miles
2 miles
POOR ORIGINAL
8.4 hrs
6.4 hrs
4.6 hrs.
4.8 hrs.
6.0 hrs
8.8 hrs
W
SW
PATUXENT RIVER
507
402
231
506
508
264
265
512
511
266
497
245
235
574
503
504
BARSTOW
BOWENS
PORT REPUBLIC
KENWOOD BEACH
CALVERT BEACH
LONG BEACH
SCIENTISTS CLIFFS
PARKER CREEK
CALLVILLE
SOLOMONS
CALIFORNIA
HALF PONE POINT
PATUXENT NAVAL AIR TEST CEN





APPENDIX A-1

CALVERT CLIFFS NUCLEAR POWER PLANT ESTIMATED EVACUATION TIME FOR VARIOUS AREAS (GOOD WEATHER)

SITE VICINITY MAP

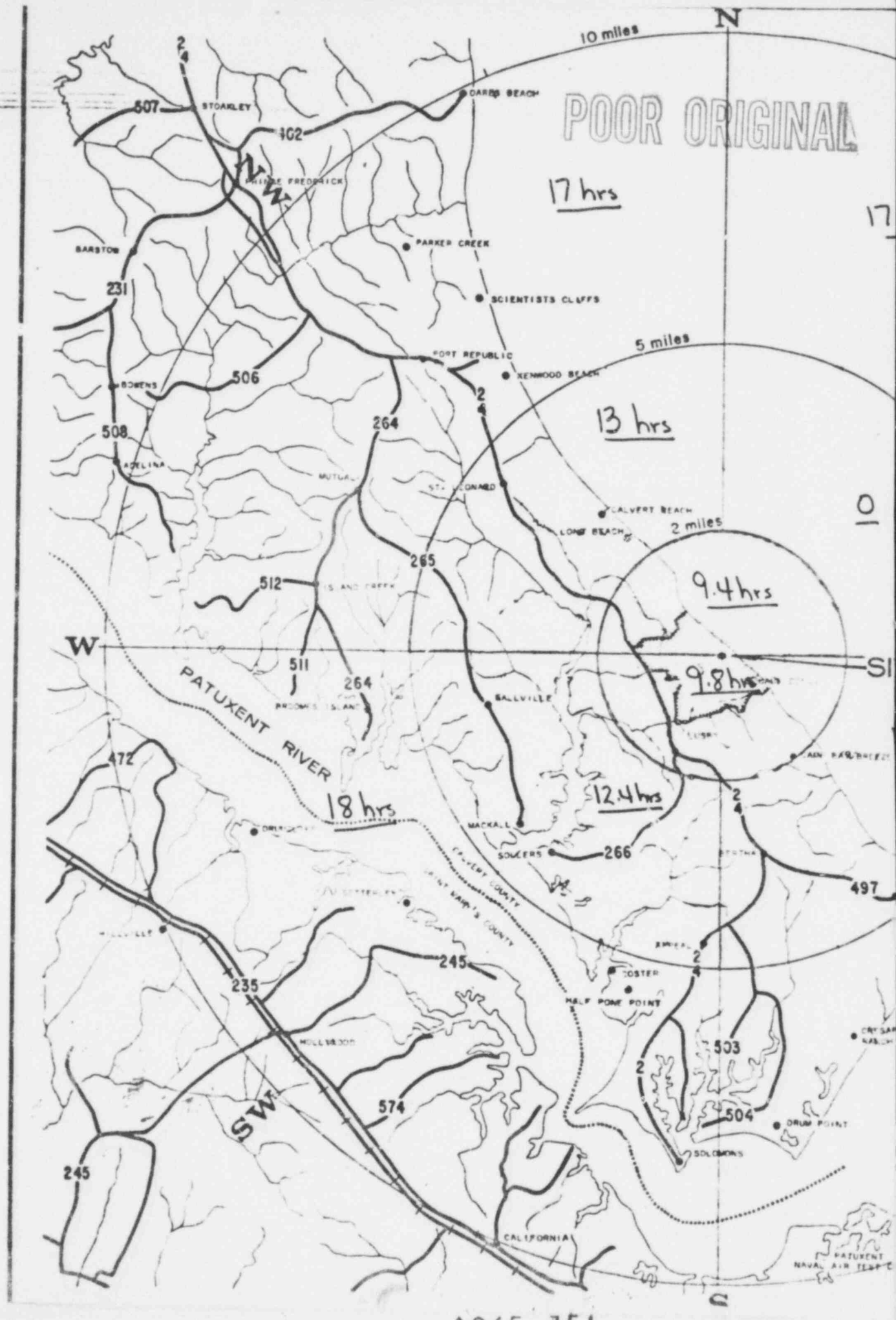
1865 350

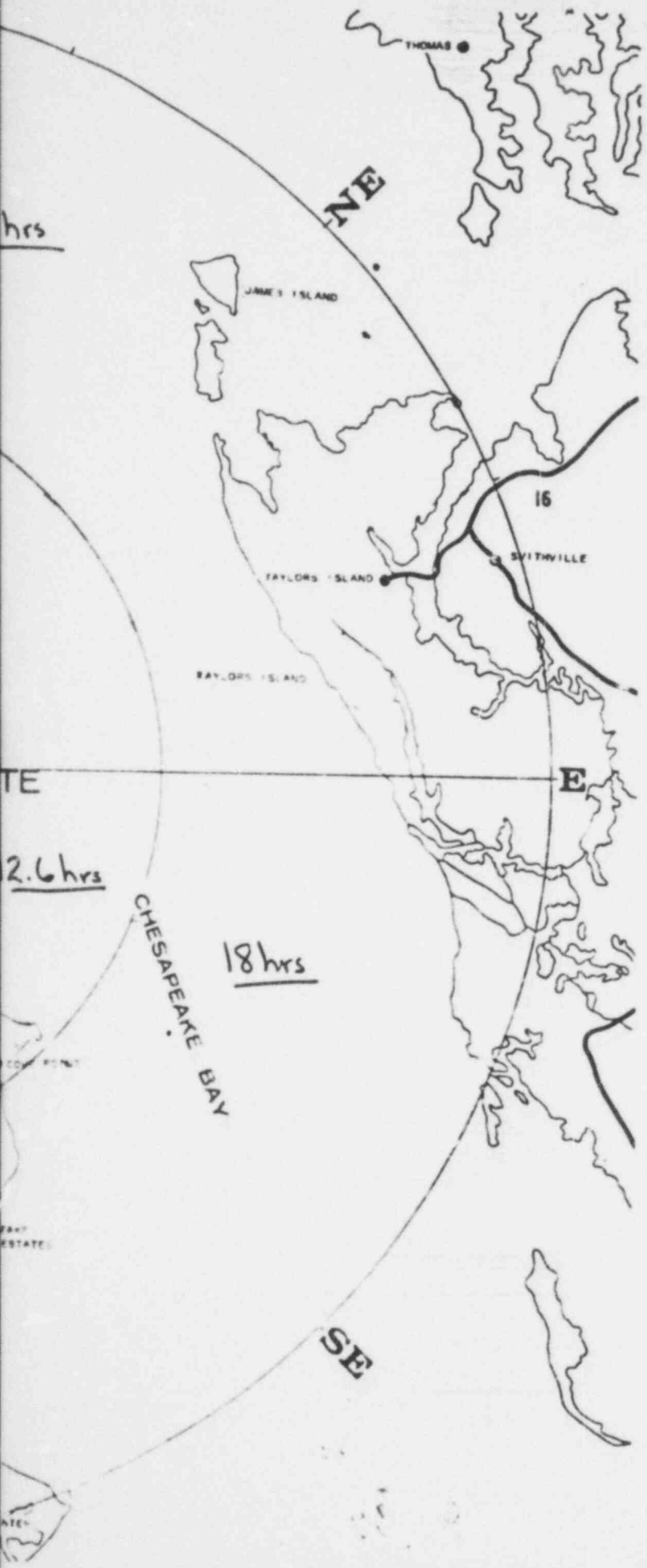
STATUTE MILES

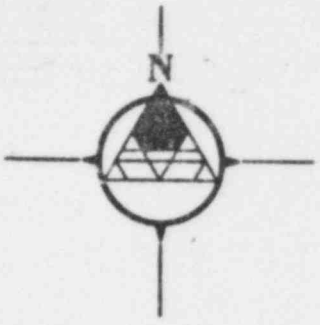
1 0 1 2

REFERENCE:

THIS MAP WAS PREPARED FROM A PORTION OF USGS WASHINGTON, D.C.-MARYLAND AND VIRGINIA 1957 TOPOGRAPHIC MAP.


POOR ORIGINAL
N
10 miles
5 miles
2 miles
17 hrs
13 hrs
9.4 hrs
9.8 hrs
12.4 hrs
18 hrs
W
SW
PATUXENT RIVER
507
502
231
506
508
264
265
512
511
472
266
497
245
235
574
503
504
STOAKLEY
PARKER CREEK
SCIENTISTS CLIFFS
FORT REPUBLIC
XENWOOD BEACH
CALVERT BEACH
LONG BEACH
BALLVILLE
MACKALL
SOLOMONS
DRUM POINT
HALF POME POINT
CALIFORNIA





APPENDIX A-2

CALVERT CLIFFS NUCLEAR POWER PLANT

ESTIMATED EVACUATION TIME FOR VARIOUS AREAS (ADVERSE WEATHER)

SITE VICINITY MAP

STATUTE MILES
1 0 1 2

REFERENCE:

THIS MAP WAS PREPARED FROM A PORTION OF USGS WASHINGTON, D.C.-MARYLAND AND VIRGINIA 1957 TOPOGRAPHIC MAP.

OTTO B. CHEESMAN, JR., DIRECTOR

Attachment 1

DORCHESTER COUNTY
OFFICE OF
CIVIL DEFENSE AND
DISASTER PREPAREDNESS AGENCY
P. O. BOX 231, COURTHOUSE
CAMBRIDGE, MARYLAND 21613
PHONE: 228-1818

January 28, 1980

Baltimore Gas & Electric Co.
P. O. Box 1475
Baltimore, Md. 21203

Att: G. E. Brobst

Dear Sir:

We have reviewed the evacuation time estimations as calculated by the Baltimore Gas & Electric Company and generally concur with the model used and results obtained as an upper time limit. It is expected that an actual evacuation of the County will consume only a fraction of the time(s) estimated, but no acceptable model is available on which to base this premise. We, therefore, give our concurrence to these times as conservative time estimations for Dorchester County evacuations.

Sincerely,

Otto B. Cheesman, Jr.
Dorchester County CD&DPA

OBC/jMc

1865 353

ST. MARY'S COUNTY
CIVIL DEFENSE AND
DISASTER PREPAREDNESS AGENCY
P. O. BOX 271
LEONARDTOWN, MARYLAND 20650

TELEPHONE: 475-8016

OTIS F. WOOD, DIRECTOR

28 January 1980

Baltimore Gas & Electric Company
P.O. BOx 1475
Baltimore, Maryland 21203

Attn: G. E. Brobst

Dear Sir:

We have reviewed the evacuation time estimations as calculated by the Baltimore Gas & Electric Company and generally concur with the model used and results obtained as an upper time limit.

It is expected that an actual evacuation of the County will consume only a fraction of the times estimated, but no acceptable model is available on which to base this premise. We, therefore, give our concurrence to these times as conservative time estimations for St. Mary's County evacuations.

Sincerely,

Thomas L. Oliver

Thomas L. Oliver
St. Mary's County Civil Defense

TLO/glp

1865 354

ATTACHMENT 3

CALVERT COUNTY
CIVIL DEFENSE

Prince Frederick, Maryland 20678

Phone (301) 535-1600 ext. 250

Director
Vernon Horsmon

January 31, 1980

Mr. Gary E. Brobst
Baltimore Gas & Electric Company
Baltimore, Maryland 21203

Dear Mr. Brobst:

After a review of your Company's evacuation estimates, we feel that the most up to date information should be used. in the computation of times and population. The data that follows is based on information available from our County Planning Office and is current as of January 1, 1980.

1. Without use of an evacuation mathmatical model, County estimated evacuation times are developed based on numbers of households, and persons in each sector, locations of house holds, and persons in each sector, locations of households (dispersed), and type of road network in the area, (linear roads mostly dead-end).

2. Household distribution, 1980, based on current data provided by the County Planning Office. For this tabulation, sectors are numbered as follows:

2 mile north half = 2 N
2 mile south half = 2 S
2-5 mile NW = 5 A
2-5 mile SW = 5 B
2-5 mile SE - 5 C
5-10 mile NW = 10 A
5-10 mile SW = 10 B (10 B figures relate only to Calvert County).
5-10 mile SE = 10 C (10 C figures relate only to Calvert County).

3. Numbers of dewlling units and population by sectors, determined from current maps and tables for 1980 are as follows:

Sector	Dwelling Units	Population
2 N	25	70
2 S	98	275
5 A	671	1900
5 B	203	600
5 C	447	1250
10 A	1750	4900
10 B	950 (1)	2660 (1)
10 C	900 (2)	2500 (2)
Totals	5044	14,100

January 31, 1980

evacuation estimations (cont.)

(1) Includes only Calvert County. The Navy Recreation Center at Solomons has a capacity for 2500 transient guests; 1250 persons are included in the figure shown.

(2) Includes only Calvert County.

4. County evacuation time estimates, based on staff studies and experience from exercises, indicates evacuation times (for Calvert County areas) as follows:

Sector	Evacuation Time (good weather)
2 N	2-4 hours
2 S	3-4 hours
5 A	6-8 hours
5 B	4-6 hours
5 C	6-8 hours
10 A	10-12 hours
10 B	6-8 hours
10 C	6-8 hours

In case of bad weather and/or bad road conditions, a factor of two for evacuation time is generally reasonable. In case of deep snow (2 to 3 feet) some County roads and long private drives may not be cleared for 2 to 3 days.

5. Special Facilities: Special attention should be given the Columbia gas LNG facility at Cove Point, and it's off-shore (6,000')loading dock. The dock can accomodate two super-tankers at one time. If the facility must be evacuated, special measures will be required to provide it's safety and security.

6. Evacuation of personnel in St. Mary's and Dorchester County should be considered separately because different jurisdictions and different road systems are involved.

7. The map used should show the Columbia gas LNG facility, and should show the Johnson Bridge (Route 2) connecting the Calvert County and St. Mary's County.

Jason C. Hamm
Director