

REPORT NO. 80107

BRUCE - DOC



B-1364-014

BRUCE G.S. SITE

SEISMIC RISK ANALYSIS

by

EARTH PHYSICS BRANCH -

DEPARTMENT OF ENERGY MINES AND RESOURCES

BRUCE B RECORDS

PHASE II

B11

MICROFILMED

F-143240

THIS IS AN ESTIMATE OF THE EARTHQUAKE PROBABILITY OF A SITE NEAR
BRULE, ONTARIO - REACTOR SITE. EASTERN CANADA REGION.

THE GEOGRAPHICAL CO-ORDINATES OF THE SITE ARE

44 DEGREES 19.0 MIN NORTH LATITUDE
81 DEGREES 36.0 MIN WEST LONGITUDE

EARTHQUAKES BETWEEN 1899 AND 1963 INCLUSIVE ARE INCLUDED IN THE ANALYSIS.

DURING THIS PERIOD THERE ARE 946 EARTHQUAKES IN THE EARTHQUAKE CATALOGUE FOR
THIS REGION. THERE WERE 23 EARTHQUAKES WHICH COULD HAVE BEEN FELT AT THIS
LOCATION DURING THIS 65 YEAR PERIOD.

THIS SITE HAS EXPERIENCED A MAXIMUM ACCELERATION OF 1. PERCENT GRAVITY
OR A MAXIMUM INTENSITY OF IV.

TABLE 1 IS A LIST OF THE EARTHQUAKES WHICH REACHED AN INTENSITY OF II (TWO)
OR GREATER AT THIS SITE. ALL OF THE EVENTS IN THIS LIST MAY HAVE BEEN FELT.

TABLE 2 IS A LIST OF THE PREDICTIONS FOR THIS SITE. PLEASE READ THE
FOLLOWING REMARKS BEFORE USING THE DATA.

** THE VALUES FOUND IN TABLE 2 ARE BASED UPON A STATISTICAL ANALYSIS OF THE
EARTHQUAKES WHICH HAVE OCCURRED OVER THE ABOVE INTERVAL OF TIME.
THIS IS TOO SHORT A PERIOD OF OBSERVATION FOR ACCURATE PREDICTIONS ABOUT
TECTONIC ACTIVITY. HOWEVER, THE DATA HAVE BEEN PROCESSED TO PROVIDE
AN ESTIMATE OF THE POSSIBLE LEVEL OF EARTHQUAKE ACTIVITY IN THE NEAR
FUTURE ASSUMING A CONTINUATION OF THE STATISTICAL PATTERN OF THE PAST
YEARS. ALTHOUGH PREDICTIONS CAN BE MADE FOR MANY RETURN PERIODS,
THE NUMBERS GIVEN FOR RETURN PERIODS GREATER THAN 100 YEARS ARE MORE LIKELY
TO BE ALTERED BY CHANGING PATTERNS OF EARTHQUAKE ACTIVITY. **

THE EXTREME VALUE METHODS OF STATISTICS ARE USED FOR THESE CALCULATIONS.
THE SLOPE OF THE CURVE IS FOUND BY A LEAST SQUARES SOLUTION OF THE DATA FOR
THE YEARS WHEN THERE WAS ACTIVITY ABOVE A FIXED THRESHOLD LEVEL. THE
CURVE IS REPRESENTED BY THE EQUATION

$$\text{LOG}(\text{ACC}) = \text{MODE} + K(-\text{LOG}(-\text{LOG}(P)))$$

WHERE NATURAL LOGARITHMS ARE USED. P IS THE PROBABILITY THAT ACC WILL NOT
BE EXCEEDED IN 1 YEAR. R IS THE RETURN PERIOD (IN YEARS) OF ACCELERATION
AMPLITUDE LOG(ACC) AND EQUALS $1/(1-P)$.

FROM THIS THE ACCELERATION AMPLITUDE IS

$$\text{ACC} = \text{EXP}(\text{LOG}(\text{ACC}))$$

AND THE INTENSITY

$$I = 3 \text{ LOG}_{10}(\text{ACC}) + 4.5$$

I IS THE INTENSITY BY THE MODIFIED MERCALLI INTENSITY SCALE OF 1931. IN
THE TABLES THE VALUE IS ROUNDED TO THE NEAREST INTEGER AND PRINTED IN ROMAN
NUMERALS. ACC IS THE ACCELERATION AS A PERCENTAGE OF GRAVITY.

THE VALUES OF ACCELERATION LISTED IN TABLE 2 ARE FOR FIRM SOIL. OTHER
TYPES OF FOUNDATION MATERIAL MAY ALTER THE VALUES BY AT LEAST ONE UNIT
IN INTENSITY OR AT LEAST A FACTOR OF 2 IN ACCELERATION AMPLITUDE.

THE SEISMIC ZONING MAP IN THE NATIONAL BUILDING CODE OF CANADA (1970) USES THE ACCELERATION AMPLITUDES WITH RETURN PERIODS OF 100 YEARS AS THE CRITERIA FOR ZONE BOUNDARIES. THIS IS CALLED ACC100. THE FOLLOWING ARE THE ZONE BOUNDARIES IN THE 1970 CODE WITH THE CORRESPONDING R-FACTORS.

ZONE 0		ACC100 < 1.	R = 0
ZONE 1	1. <=	ACC100 < 3.	R = 1
ZONE 2	3. <=	ACC100 < 6.	R = 2
ZONE 3	6. <=	ACC100	R = 4

* SUPPLEMENT NO.4 TO THE NATIONAL BUILDING CODE OF CANADA 1970, COMMENTARY NO.3 DESCRIBES "EARTHQUAKE LOADS". *

BRUCE, ONTARIO - REACTOR SITE. EASTERN CANADA REGION.

44 19.0 N 81 36.0 W

TABLE 1

ACCELERATION AND INTENSITY FROM PREVIOUS EARTHQUAKES CALCULATED FOR CHOSEN SITE

DATE N DY	YEAR	MAG	LAT	LONG	DISTANCE		ACCELERATION PERCENT G	INTENSITY
					MILES	KMS		
7027	1905	5.6	47.3	-88.4	386	622	0	II
9027	1909	5.7	39.0	-87.7	483	777	0	II
3027	1912	4.3	43.2	-79.7	122	196	0	II
2010	1914	5.5	45.0	-76.9	234	377	0	III
9030	1924	6.1	47.6	-69.7	614	988	0	II
3001	1925	7.0	47.6	-70.1	596	959	1	IV
8012	1929	5.8	42.9	-78.3	190	307	1	IV
9020	1931	5.7	40.2	-84.3	316	508	0	III
11001	1935	6.3	46.6	-79.1	209	337	1	IV
11002	1935	5.4	47.2	-78.2	260	418	0	III
3002	1937	5.3	40.7	-84.0	278	447	0	II
3009	1937	5.5	40.6	-84.0	284	457	0	III
12020	1940	5.8	43.8	-71.3	512	824	0	II
12024	1940	5.8	43.8	-71.3	515	829	0	II
3009	1943	5.5	42.2	-80.9	150	242	1	IV
9005	1944	5.9	45.0	-74.9	332	534	0	III
1009	1947	5.0	42.0	-85.0	234	377	0	II
2025	1952	3.6	43.8	-81.0	44	72	0	III
2021	1954	5.7	41.2	-75.9	360	579	0	III
1024	1958	3.5	42.0	-81.3	48	78	0	II
5014	1958	5.4	47.0	-76.0	304	490	0	II
6029	1957	4.2	42.9	-81.3	97	156	0	II
5026	1909	5.6	42.5	-69.0	391	630	0	II

TABLE 2

PREDICTIONS FOR CHOSEN SITE
(READ REMARKS ON PAGES 1 AND 2)

44 19.0 N 81 36.0 W

DE FOR THIS SITE = -2.80
FOR THIS SITE = .70

C100 FOR THIS SITE = 1.5 PERCENT GRAVITY

PROBABILITY ACC BEING EXCEEDED IN YEAR.	ACC IN PERCENTAGE GRAVITY	INTENSITY (MODIFIED MERCALLI)	EQUIVALENT RETURN PERIOD
.333	0	II	3.
.100	1	III	10.
.033	1	IV	30.
.020	1	IV	50.
.010	1	V	100.
.005	2	VI	200.
.003	3	VI	300.
.001	7	VII	1000.