



UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

PDR

NOV 1 1979

MEMORANDUM FOR: Harold R. Denton, Director
Office of Nuclear Reactor Regulation

Robert B. Minogue, Director
Office of Standards Development

FROM: Saul Levine, Director
Office of Nuclear Regulatory Research

SUBJECT: RESEARCH INFORMATION LETTER NO. 64
"A REVISED AND AUGMENTED LIST OF EARTHQUAKE INTENSITIES
FOR KANSAS, 1867-1977"

REFERENCES: 1. Letter W. R. Stratton to Dixie Lee Ray dated May 16,
1973. Subject: Report on Seismic Research

2. Title 10, Chapter 1, Part 100, CFR Appendix A -
Seismic and Geologic Siting Criteria for Nuclear
Power Plants

3. Memo N. B. Steuer to R. J. Mattson, dated
July 15, 1975, Subject: U.S. Tectonic Province Map

INTRODUCTION

This memo transmits NUREG/CR-0294 entitled, "A Revised and Augmented List of Earthquake Intensities for Kansas, 1867-1977." The research effort to produce this report was conducted by the Kansas Geological Survey. This research is a cooperative geologic, seismic and geophysical effort of the State Geological Surveys of Kansas, Oklahoma, Nebraska, Iowa and Minnesota to study the earth science parameters of the Nemaha Uplift and the Midcontinent Gravity Anomaly. The Nemaha Uplift and Midcontinent Gravity Anomaly are buried geologic structures along which there has been a history of earthquake activity. Hence, a knowledge of the Nemaha Uplift and Midcontinent Gravity Anomaly are of vital importance in the siting and licensing of nuclear power plants.

SUMMARY

The Kansas Geological Survey, in cooperation with the state geological surveys of Oklahoma, Nebraska, and Iowa, is conducting a 5-year study of the regional tectonics and seismicity of the Nemaha Uplift and other regional geologic structures of the central midcontinent.

The purpose of this research is to gain a better understanding of the sources of earthquakes that have occurred in the region as an aid to developing a more rational evaluation of earthquake risk as it applies to the siting and design of nuclear facilities.

The studies are funded jointly by the Division of Reactor Safety Research, U.S. Nuclear Regulatory Commission; the Kansas City District, U.S. Corps of Engineers; and the Kansas Geological Survey, University of Kansas. This NUREG presents a revised and augmented list of earthquake intensities for Kansas, 1867-1977.

The elements of the overall study, as proposed, are: (1) a reinventory of historic earthquakes in Kansas; (2) regional surface and subsurface geologic studies; (3) regional aeromagnetic and gravity studies; (4) regional studies of specific areas; (5) detailed surface and subsurface studies of specific areas; (6) acquisition, installation, and operation of a regional seismograph network for recording microearthquakes; (7) exploration seismology for location of faults; (8) synthesis and analysis of data from above studies and integration with that from studies being done in adjacent states. A summary of the above project activities to the end of the second year, or September 30, 1978, are presented in NUREG/CR-0666.

Twenty-five earthquakes, whose epicenters were within the borders of Kansas, have been reported during about the past 110 years. Two large nuclear and coal-fired electrical generating complexes and several existing or proposed reservoirs are sited near or in areas of past seismic activity in Kansas. The seismic design parameters for these facilities are based largely upon the locations, sizes, and frequency of earthquakes which have occurred in the region as far back as reports are available. Because of the critical nature of this information in estimation of seismic risk, it is important that the date, location, and size of each earthquake be determined as accurately as possible.

The original purpose of this study was to verify the basis for placement of the 1867 and 1906 earthquake epicenters near Manhattan, Kansas. It was subsequently expanded to review the reports on all earthquakes whose epicenters were within the boundaries of Kansas. The investigation included a review of the references cited for Kansas earthquakes by authors of previously published state, regional, and national earthquake listings. In addition, old newspaper files, microfilms, and other records at the University of Kansas and the Kansas State Historical Society were searched for reports which may have been previously overlooked or not recorded.

As a result of this study, the authors believe that three changes in epicenter locations should be made, including those of the two largest earthquakes:

<u>Date</u>	<u>MM Intensity</u>	<u>Location</u>	<u>From</u>	<u>To</u>
April 24, 1867	VII-VIII	22 mi. NW Manhattan	Wamego vicinity	
Nov. 8, 1875	V	Valley Falls	Topeka vicinity	
Jan. 7, 1906	VII	10 mi. N. Manhattan	Manhattan vicinity	

Changes in Modified Mercalli intensities for five earthquakes were made:

<u>Date</u>	<u>MM Intensity</u>		<u>Location</u>
	<u>From</u>	<u>To</u>	
Mar. 18, 1927	V	VI	White Cloud
Nov. 26, 1929	IV	V	Ashland
Aug. 9, 1931	IV-V	VI	Turner
Jan. 28, 1932	III, V	VI	Ellis
Nov. 10, 1942	III, IV	V	Hays

This report includes a complete list of all felt reports compiled during this study.

The proposed construction of several large nuclear or coal-fired electrical generating complexes, dams, and other critical facilities in or near areas associated with past seismic activity in Kansas has raised questions concerning future earthquake probability and risk.

The location, size, and frequency of past earthquakes are presently used in calculating the seismic design parameters for such facilities. An additional safety factor is usually applied because the design life of a major dam and reservoir, for example, is approximately twice the 110-year period of record for reported earthquakes in Kansas. Because of the critical nature of such listings, it is important that the catalog be as complete and correct as possible. Figure 1 depicts the Nemaha Ridge, earthquake epicenters and intensities.

The State Geological Surveys of Oklahoma, Kansas, and Nebraska are presently making a 5-year detailed study of the sources of seismicity in the Nemaha Uplift area for the Site Safety Research Branch, Division of Reactor Safety Research, U.S. Nuclear Regulatory Commission. This report comprises a part of that research.

BACKGROUND

Refer to RIL No. 48, "A Tectonic Overview of the Midcontinents." The background information in RIL No. 48 applies equally to this RIL. It covers ACRS recommendations, relevance of 10 CFR Part 100 Appendix A to the study, and previous NRC effort and organization of the current programs.

CRITERIA FOR STUDY AREA SELECTION AND OBJECTIVES OF STUDY

Please refer to NUREG/CR-0666 and/or the RIL entitled, "A Study of the Regional Tectonics and Seismicity of Eastern Kansas - Summary of Project Activities and Results to the End of the Second Year or September 30, 1978." The criteria are the same for this RIL.

RESULTS

Results of this study are included in the SUMMARY Section beginning on Page 1.

PLANNING

A 5-year multidisciplinary study in cooperation with the Nebraska, Oklahoma, Iowa and Minnesota Geological Surveys is planned. The study will outline the geology, structure, tectonics and seismicity of the Nemaha Uplift and Midcontinent Gravity Anomaly region.

Project work is planned in three separate but interrelated phases which are:

1. Existing data synthesis;
2. Acquisition of new data, seismic network installation and operation; and
3. Final synthesis of new and old data, interpretation, map and report preparation.

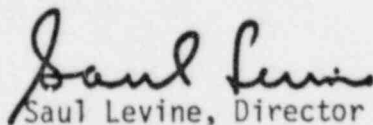
This is an interim topical report that presents some results of work completed in Phase I.

RECOMMENDATIONS

It is recommended that the information in NUREG/CR-0294 be considered by the Office of Standards Development and the Office of Nuclear Reactor Regulation as input to the development of a tectonic province or seismic zoning map of the eastern U.S. and to provide a basis and guide for ongoing studies in the area.

Additionally, RES recommends that studies be continued in this area to attain the objectives previously stated. It is also recommended that researchers make annual oral presentations to all NRC geologists and seismologists so that work progress can be discussed and the program redirected and/or modified as deemed necessary.

Technical questions concerning NUREG/CR-0294 may be directed to Neil B. Steuer at 427-4370.

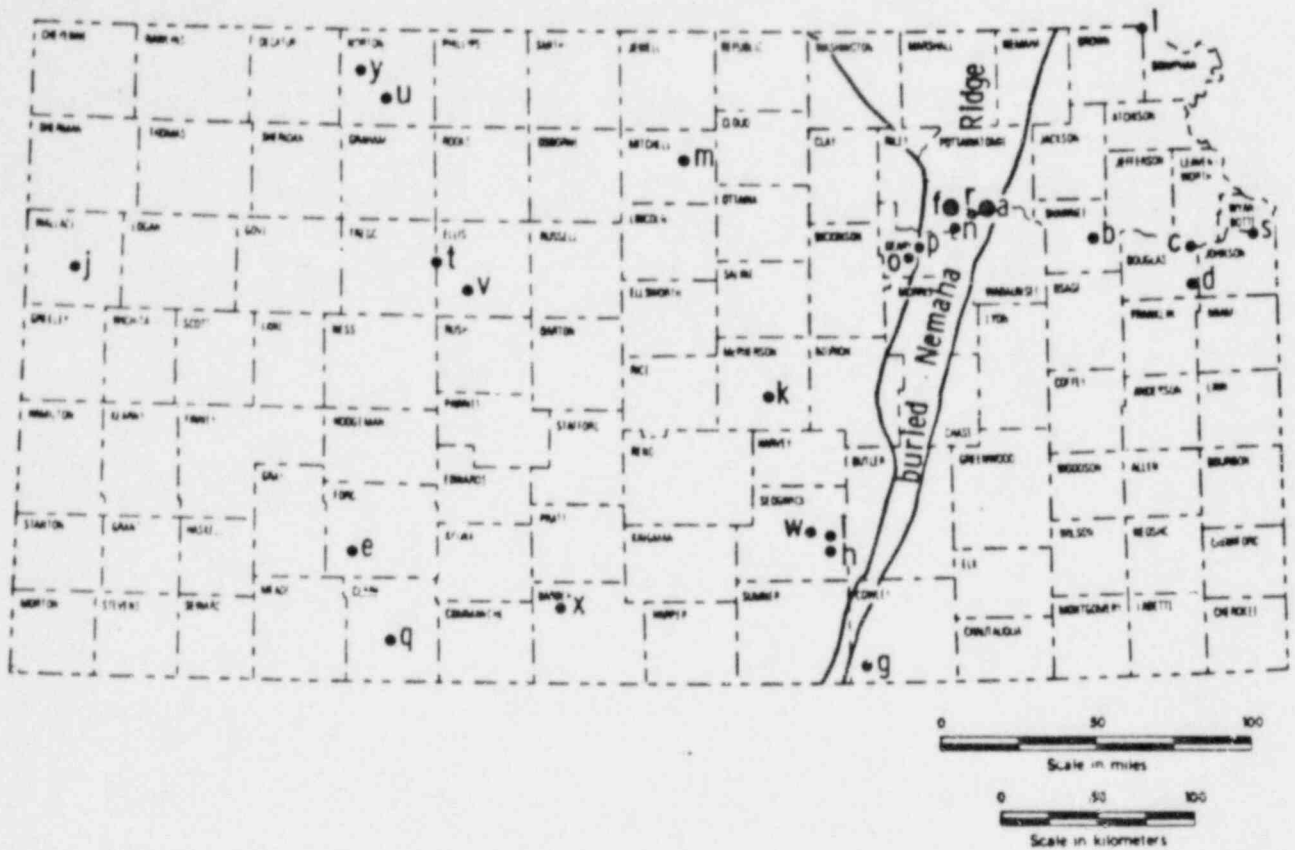


Saul Levine, Director
Office of Nuclear Regulatory Research

Enclosures:

1. NUREG/CR-0294
2. Figure 1

EARTHQUAKES IN KANSAS



Explanation

a 1867	VIII	f 1906	VII	k 1927	V	p 1929	V	u 1933	V
b 1875	V	g 1907	IV	l 1927	VI	q 1929	V	v 1942	IV
c 1881	III	h 1919	IV	m 1928	IV	r 1929	V	w 1948	IV
d 1903	II	i 1919	IV	n 1929	V	s 1931	VI	x 1956	VI
e 1904	IV.	j 1926	?	o 1929	V	t 1932	VI	y 1961	V

Location and dates of earthquakes in Kansas during the past 110 years. The number following the date is the earthquake intensity on the Modified Mercalli Scale.

Fig. 1

Harold R. Denton
Robert B. Minogue

Distribution
Subj
Circ
Chron
NBSteuer rf
JHarbour cy
LBeratan cy
JJackson cy
RMKenneally cy
LCShao cy
TEMurley cy
JLarkins cy
RJBudnitz cy
SLevine cy

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Saul Levine, Director
Office of Nuclear Regulatory Research

GRSR:SSRB
Steuer/mt/Harbour
9/20/79
Kenneally/Shao
9/17/79 9/17/79
RSR:DIR
TEMurley
9/17/79

Enclosures:

1. NUREG/CR-0294

2. Figure 1

OFFICE	RES:PCB	RES:DEPD	RES:DIR
SURNAME	LBeratan	JLarkins	RJBudnitz
DATE	9/24/79	9/17/79	9/17/79

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- 4 -

Distribution:
Subject
Circ
Chron
Steuer, rf
Harbour, cy
Kenneally, cy
Shao, cy
Murley, cy
Larkins, cy
Budnitz, cy
Levine, cy
Beratan, cy
Jackson, cy

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Original Signed By
Saul Levine

GRSR:SSRB*
N. Steuer/ddh/J. Harbour
9, 20/79

Saul Levine, Director
Office of Nuclear Regulatory Research

Enclosures:

* see previous yellow for concurrence *RMK 10/3*

1. NUREG/CR-0294						
OFFICE	2. Figure 1	SD: BC*	NRR: BC*	GRSR:SSRB	RES	RES:D
SURNAME		L. Beratan	R. Jackson	Shao Murley	J. Larkins R. Budnitz	S. Levine
DATE		09/24/79	09/25/79	10/26/79	1/179	11/1/79

RSB 11/1/79