KANSAS GAS AND ELECTRIC COMPANY

GLENN L. KOESTER
VICE PRESIDENT - NUCLEAR

October 27, 1981

Mr. Harold R. Denton, Director
Office of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

KMLNRC 81-129
Re: Docket No. STN 50-482
Ref: Letter dated 9/15/81 from BJYoungblood, NRC, to GLKoester
Subj: Geology

Dear Mr. Denton:

The Referenced letter requested additional information in the area of geology. Transmitted herewith is the response to Question 231.5WC. This response will be formally incorporated into the Wolf Creek Generating Station, Unit No. 1, Final Safety Analysis Report in Revision 7. This information is hereby incorporated into the Wolf Creek Generating Station, Unit No. 1, Operating License Application.

Yours very truly,

Glenn L Koester

GLK:bb
Attach

cc: - Dr. Gordon Edison (2)
Division of Project Management
Office of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Mr. Thomas Vandel
Resident NRC Inspector
P.O. Box 311
Burlington, Kansas 66839

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OATH OF AFFIRMATION

STATE OF KANSAS)
) SS:
COUNTY OF SEDGWICK)

I, Glenn L. Koester, of lawful age, being duly sworn upon oath, do depose, state and affirm that I am Vice President - Nuclear of Kansas Gas and Electric Company, Wichita, Kansas, that I have signed the foregoing letter of transmittal, know the contents thereof, and that all statements contained therein are true.

KANSAS GAS AND ELECTRIC COMPANY

ATTEST:

By Glenn L Koester
Glenn L. Koester
Vice President - Nuclear

W.B. Walker, Secretary

STATE OF KANSAS)
) SS:
COUNTY OF SEDGWICK)

BE IT REMEMBERED that on this 27th day of October, 1981, before me, Evelyn L. Fry, a Notary, personally appeared Glenn L. Koester, Vice President - Nuclear of Kansas Gas and Electric Company, Wichita, Kansas, who is personally known to me and who executed the foregoing instrument, and he duly acknowledged the execution of the same for and on behalf of and as the act and deed of said corporation.

IN WITNESS WHEREOF, I have hereunto set my hand and affixed my seal the day and year above written.

EVELYN L. FRY NOTARY PUBLIC

Evelyn L. Fry
Evelyn L. Fry, Notary

My Commission expires on August 15, 1984.

Question 231.5WC:

Discuss the following recent studies and their significance to the Wolf Creek site:

1. H. Yarger et al. 1981, Bouguer gravity map of Southeastern Kansas, Kansas Geological Survey, Open-File Report.

2. Steeples, D.W., 1981, Microearthquake network activities, Fiscal Year 1980, Kansas Geological Survey, Report to the Kansas City District Corps of Engineers.

3. Steeples, D.W., 1981, Structure of the Salina-Forest City interbasin boundary from seismic studies, Kansas Geological Survey, prepared for the W.H. McNutt Memorial Lecture Series.

Response:

The recent publications cited in question 231.5WC were reviewed and are discussed below as inter-related data.

The Bouguer gravity maps of northeastern and southeastern Kansas (Yarger & others, 1980; Yarger & others, 1981) were spliced together to produce the composite in Figure 231.5-1 (attached). The most striking feature on Figure 231.5-1 is the large, northeast trending, positive gravity anomaly located in the northwestern portion of the map. This positive gravity anomaly reflects mafic intrusives or lava flows related to the buried Central North American Rift System (CNARS) (See FSAR Section 2.5.1.1.5.1.17 and FSAR Figures 2.5-7 to 2.5-10). The flanking gravity lows reflect the presence of Precambrian clastic deposits associated with this ancient rift (See FSAR Section 2.5.1.1.5.1.17 and FSAR Figures 2.5-13 and 2.5-14; Steeples, 1981b).

A relatively steep north-trending gravity gradient located just east of N40.0° - E96.0° appears to be related to the Humboldt fault zone. The gradient curves toward the west about 20 km south of the Nebraska border. This curvature may reflect either a branch of the Humboldt fault zone or an indirect relationship between the gravity gradient and fault zone (Steeples, 1981b). The origin of the gravity low in the Forest City Basin (northeastern part of Figure 231.5-1) is not known (Steeples, 1981b).

A comparison between aeromagnetic and gravity anomaly maps (FSAR Figure 2.5-9 and Figure 231.5-1 shows that, in general, the circular positive aeromagnetic anomalies in the Forest City Basin are not associated with positive gravity anomalies. The origin of these aeromagnetic anomalies (younger Precambrian granites intruded into older Precambrian granite terrane) has been discussed elsewhere and accounts for the absence of corresponding positive gravity anomalies (FSAR Section 2.5.1.1.5.1.17; Response to Question 230.4WC).

An almost circular gravity low (-65 to -67 mgal) in Osage County, approximately 15 miles due north of the site corresponds with a circular positive aeromagnetic anomaly (1000 to 2000). The coincidence of a magnetic high and gravity low may indicate that the underlying crust contains an intrusion different in composition from the Miami and Douglas County Precambrian granites (Steeples & Bickford, 1981).

Steeples (1981b) discusses the closely spaced aeromagnetic contours in Osage County (north of Coffey Co.) that curve sharply from a northwest to a northeast trend, the "Osage elbow." Steeples (1981b) infers that this feature reflects block faulting in the crystalline basement that may have effected overlying sediments during the Pennsylvanian. There is no directly comparable feature on the Bouguer gravity anomaly map.

A gravity low at approximately 37°42'N, 96°26'W lies within the Wichita aeromagnetic low (Figure 231.5-1; Response to NRC Question 230.4WC; Yarger, 1981a). The shapes of these lows are not coincident and the origin of the Wichita low is not known.

An area of relatively high Bouguer gravity values is located in extreme southeastern Kansas (Figure 231.5-1). This gravity high encompasses an area containing isolated positive aeromagnetic highs. The region of high gravity values may represent Precambrian felsic volcanic terrane whereas coincidence with aeromagnetic highs may reflect undiscovered mafic intrusions (Bickford & others, 1979).

It is interesting to note that contour trends visible on the 1964 Bouguer gravity map of the United States (FSAR Figure 2.5-8) have been defined in greater detail on Figure 231.5-1. This observation can be corroborated by following the -60 mgal contour at the site on FSAR Figure 2.5-8 and comparing it with the -60 mgal contour on figure 231.5-1. This comparison indicates that the major northeast

and northwest trends visible on FSAR Figure 2.5-8 have been defined in greater detail by recent surveys.

The Bouguer gravity map of southeastern Kansas shows that there are no closely spaced contours indicating sharp gravity gradients in Coffey County (Yarger & others, 1981). Detailed analysis of the Bouguer gravity map, other geophysical data and subsurface data will add to our knowledge of crust and mantle structure beneath eastern Kansas. On the basis of these data, there are no indications of crustal features that may represent a hazard to site safety.

Steeples (1981a) lists all microearthquakes recorded by the Kansas Geological Survey's microearthquake network between 1977 and May 1, 1981. Maps showing these epicentral locations show no new trends that have not been discussed elsewhere (Steeples, 1981a; FSAR Section 2.5.2). Microearthquakes in Nemaha and Wabaunsee counties and in southern Cowley County appear to have occurred along segments of the Humboldt fault zone. Two epicenters are located in the vicinity of a northwest trending fault on the Precambrian surface, northeast of lineament No. 6 (Figure 231.2-1; Fault No. 24 - FSAR Figure 2.5-16, Table 2.5-10). Other microearthquake epicenters occur along the northwest margin of the CNARS. As discussed in FSAR Section 2.5.2.3, this microearthquake activity indicates that portions of the Humboldt fault zone and margins of the CNARS appear to be seismogenic.

According to Steeples (1981a), a sensitivity analysis of the Kansas microearthquake network indicates that magnitude 1.5 earthquakes will be detected within 200 miles of the site toward the northwest, north and northeast. Magnitude 1.5 earthquakes occurring within 140 miles toward the southeast will be detected. The microearthquake network will detect all magnitude 2.0 quakes within 200 miles of the site, except for parts of northwestern Arkansas and southcentral Missouri. The network will detect all earthquakes as small as magnitude 2.2 within 200 miles of the site.

The data summarized above are significant to site safety in that seismicity appears to occur along segments of the Humboldt fault zone, Nemaha Uplift faults and CNARS border faults, consistent with conclusions stated in FSAR Section 2.5.2. In addition, no microearthquake trends have appeared in the site vicinity or along previously unknown structures.

Steeples (1981b) discusses the structure and tectonic history of the Salina and Forest City basins and the intervening Nemaha ridge and anticline. Seismic reflection data confirm statements presented in the Wolf Creek FSAR. In summary, Steeples (1981b) states:

- The Nemaha Uplift basement consists of cataclastically deformed granite;
- The Humboldt fault zone is an approximately 200 m wide zone of complex deformation rather than a single, continuous fault;

- Folding and faulting of Pennsylvanian sediments indicates that continuous or sporadic uplift of the Nemaha ridge occurred contemporaneously with Pennsylvania sedimentation;

- Faulting along the Humboldt fault zone in northern Nemaha county affects Permain rocks but based on the interpretation of seismic reflection records, displacement may be on the order of 12 m, rather than 50-75 m (DuBois, 1978);

- The pattern of microearthquake epicenters indicates that many faults along the Nemaha Uplift have been experiencing slight adjustments at depth. Earthquakes have been occurring within a wide zone of deformation rather than along one continuous fault; and

- Microearthquakes in Washington, Republic and Cloud counties appear to be related to faulting within the CNARS. Epicenters in Barber County are probably related to basement faults associated with a southeastward extension of the CNARS.

Steeples (1981b) hypothesizes that petroleum and mineral deposits in the Forest City Basin may be more widespread than previously believed and may have formed due to the passage of a mantle hot spot beneath Kansas during the Cretaceous. If this hypothesis proves to be correct, there will be no adverse impact on the site because the Applicant controls all mineral rights within the site boundaries.

The publications discussed above are significant in that they contribute further to our knowledge of geology and seismology in the site region. The data contained within these publications supports statements contained within the FSAR concerning geologic structures, tectonic history,

geophysical anomalies, and seismicity. There are no data within these publications that indicate the existence of a feature that would represent a hazard to site safety.

References Used in Response to Question 231.5WC

1. Bickford, M.E., Harrower, K.L., Nusbaum, R.L., Thomas, J.J., and Nelson, G.E., 1979, Preliminary geologic map of the Precambrian basement rocks of Kansas: Kansas Geological Survey, Map M-9, Scale 1:500,000.

2. DuBois, S.M., 1978, The origin of surface lineaments in Nemaha County, Kansas: U.S. Nuclear Regulatory Commission, NUREG/CR-0321, 36 p.

3. Steeples, D.W., 1981a, Microearthquake network activities, fiscal year 1980: Kansas Geological Survey, Report to the Kansas City District, Corps of Engineers, July 29, 1981.

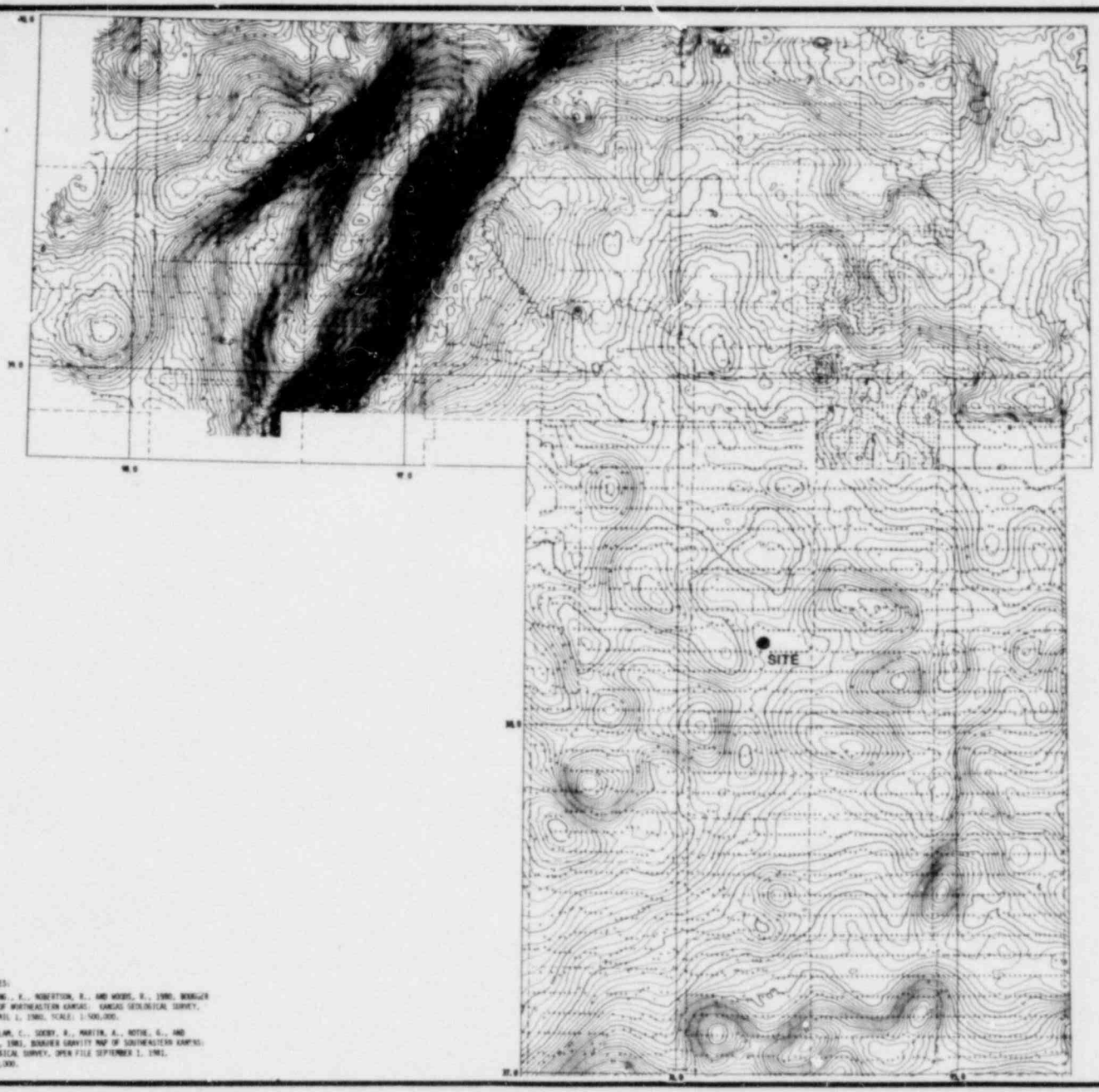
4. Steeples, D.W., 1981b, Structure of the Salina-Forest City interbasin boundary from seismic studies: Kansas Geological Survey prepared for the W.H. McNutt Memorial Lecture Series, to be published in Univ. Missouri (Rolla) Journal No. 3, 36 p.

5. Steeples, D.W., and Bickford, M.E., 1981, Piggyback drilling in Kansas: An example for the continental Scientific Drilling Program: EOS (Trans., American Geophysical Union), Vol. 62, No. 18, p. 473-476.

6. Yarger, H.L., 1981, Aeromagnetic survey of Kansas: EOS (Trans. American Geophysical Union), Vol. 26, No. 17, p. 173-178.

7. Yarger, H., Lam, C., Sooby, R., Martin, A., Rothe, G., and Steeples, 1981, Bouguer gravity map of southeastern Kansas: Kansas Geological Survey, Open-File September 1, 1981, Scale 1:500,000.

8. Yarger, H., Ng., K., Robertson, R., and Woods, R., 1980, Bouguer gravity map of northeastern Kansas: Kansas Geological Survey, Open-File April 1, 1980, Scale 1:500,000.



KEY:

INDICATES THE BOUNDARY BETWEEN THE BOUGUER GRAVITY MAP OF NORTHEASTERN KANSAS AND BOUGUER GRAVITY MAP OF SOUTHEASTERN KANSAS.

10 0 10 20 30 40

MILES

BOUGUER GRAVITY FIELD OF THE EARTH IN MILLIGALS

CONTOUR INTERVAL 1 MILLIGAL

MAP REFERENCES:

YARGER, H., NG., K., ROBERTSON, R., AND MOORE, R., 1980, BOUGUER GRAVITY MAP OF NORTHEASTERN KANSAS: KANSAS GEOLOGICAL SURVEY, OPEN FILE APRIL 1, 1980, SCALE: 1:500,000.

YARGER, H., LAW, C., SOOBY, R., MARTIN, A., ROTHE, G., AND STEEPLES, D., 1981, BOUGUER GRAVITY MAP OF SOUTHEASTERN KANSAS: KANSAS GEOLOGICAL SURVEY, OPEN FILE SEPTEMBER 1, 1981, SCALE: 1:500,000.

WOLF CREEK GENERATING STATION
UNIT NO. 1
FINAL SAFETY ANALYSIS REPORT

FIGURE 231.5-1

BOUGUER GRAVITY MAP OF EASTERN KANSAS