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BEFORE THE ARIZONA POWER PLAN AND TRANSMISSION LINE SITING COMMITTEE

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AZ CORP COMMISSION DOCKET CONTROL

IN THE MATTER OF THE APPLICATION OF SUNZIA TRANSMISSION LLC, IN CONFORMANCE WITH THE REQUIREMENTS OF ARIZONA REVISED STATUTES 40-360, ET SEQ., FOR A CERTIFICATE OF ENVIRONMENTAL COMPATIBILITY AUTHORIZING THE SUNZIA SOUTHWEST TRANSMISSION PROJECT, WHICH INCLUDES THE CONSTRUCTION OF TWO NEW 500 KV TRANSMISSION LINES AND ASSOCIATED FACILITIES ORIGINATING AT A NEW SUBSTATION (SUNZIA EAST) IN LINCOLN COUNTY, NEW MEXICO, AND TERMINATING AT THE PINAL CENTRAL SUBSTATION IN PINAL COUNTY, ARIZONA. THE ARIZONA PORTION OF THE PROJECT IS LOCATED WITHIN GRAHAM, GREENLEE, COCHISE, PINAL, AND PIMA COUNTIES.

DOCKET NO. L-00000YY-15-0318-00171

Case No. 171

NOTICE OF FILING OF SUMMARY TESTIMONY

Pursuant to Item 16 of the Procedural Order issued by Chairman Chenal on September 11, 2015 for the above-referenced case, I am hereby filing a summary of testimony for myself as a witness for the main proceeding and a summary of testimony for myself and other potential witnesses for Points of Interest W#3 and W#4 for the Willcox area tour.

Respectfully submitted this 13th day of October 2015

Norm "Mick" Meader

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Arizona Corporation Commission DOCKETED

OCT 13 2015

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JAN 13 2016

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the foregoing hand delivered this 13<sup>th</sup>  
2 day of October 2015 to:

3 Arizona Corporation Commission  
Docket Control  
4 1200 W. Washington Street  
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6 COPY of the foregoing emailed this  
13<sup>th</sup> day of October 2015 to each  
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1                                   **TESTIMONY SUMMARY OF NORM "MICK" MEADER**

2                                   **ON BEHALF OF HIMSELF**

3           I first came to Tucson in 1975 for graduate school in the Department of Geosciences  
4 (geology) at the University of Arizona, from which I graduated in 1977 with an M.S. degree.  
5 After graduating from the UA I worked in the oil industry for 8 years, where I was trained in  
6 geophysical interpretation. In 1987 I returned to work as an administrative assistance for the  
7 Geophysics Group in the Department, retiring in 2010 after 23 years of service (see attached  
8 curriculum vitae). I have lived permanently in Tucson since 1986 and am a landowner and part-  
9 time resident of Cascabel on the San Pedro River.

10           I first became involved in the Cascabel area in 1997 when I joined a ranching-  
11 conservation organization called the Saguaro-Juniper Corporation. I subsequently joined the  
12 Cascabel Hermitage Association (now the Cascabel Conservation Association), which owns 600  
13 acres of desert upland east of the San Pedro River and offers facilities for solitary desert retreats  
14 to the public. In 2012 I was chosen to be co-chair of the Cascabel Working Group, a broad  
15 community organization formed in 2007 to address large infrastructure projects that threaten the  
16 valley. In 2015 I was nominated and selected to be co-president of the Cascabel Conservation  
17 Association

18 **TOPICS TO BE COVERED**

19           My testimony will address the following topics, which are addressed more fully in the  
20 subsequent discussion.

- 21           1. The stated need for the project to meet renewable energy requirements in Arizona and  
22 California;
- 23           2. The stated need for the project to address reliability, congestion, and transfer capacity  
24 on the existing transmission system in southwestern New Mexico and southeastern Arizona;

1 3. Conflicts with the use of central and western Arizona's existing and planned  
2 transmission capacity to deliver New Mexico renewable energy to California;

3 4. Conflicts with Arizona's solar energy development and export plans in central and  
4 western Arizona and the impact of the Salt River Project's planned natural gas generation plants  
5 on the project's Arizona transmission needs;

6 5. Conflicts with the planned Southline Transmission Project, which parallels SunZia in  
7 southwestern New Mexico and southeastern Arizona;

8 6. The stated need for the project to create jobs and what the actual job potential is.

9  
10 **TOPIC 1: MEETING ARIZONA AND CALIFORNIA RENEWABLE ENERGY NEEDS**

11 SunZia's Application states that the project would help meet Arizona's renewable energy  
12 needs under its 15% Renewable Energy Portfolio Standard (RPS) and would help the state  
13 respond to the EPA's proposed Clean Power Plan. A review of Arizona renewable energy  
14 potential, however, shows that Arizona's own resources could meet all of our state's full power  
15 requirements many times over and that Arizona itself wants to export excess renewable energy to  
16 California. Arizona's utility-scale RPS requirement is only 10.5% (30% must be met with  
17 distributed solar energy). By the end of 2015, 12% of Arizona Public Service's will already be  
18 from renewable sources. The Salt River Project, Arizona's other large utility, is not governed by  
19 the Arizona Corporation Commission and is not required to meet the standard.

20 A review of past and present proposed renewable energy projects in Arizona shows that  
21 thousands of megawatts of capacity have remained unbuilt because of a lack of need. To date,  
22 Arizona has been able to export only 545 megawatts of capacity to California, with more than  
23 3,000 megawatts of planned capacity remaining unsold. The BLM's Solar Programmatic  
24 Environmental Impact Statement shows that as of 2012 some 16,500 megawatts of solar capacity

1 had been proposed for Arizona BLM lands mostly in central and western Arizona, almost all of it  
2 lying dormant. Carmine Tilghman of Tucson Electric Power Company, a project partner, notes  
3 that only California energy use could justify SunZia. In addition, studies by both Arizona Public  
4 Service and Tucson Electric Power show that Arizona solar energy is far more capable of  
5 helping meet Arizona peak demand than New Mexico wind.

6 California's utilities have easily met the state's 33% Renewable Portfolio Standard set for  
7 2020 with in-state resources. In 2011 alone some 91,000 megawatts of capacity was proposed,  
8 nearly double the entire power requirements of the state. Following that bid season California  
9 utilities signed sufficient power purchase agreements for renewable energy to meet 40% of the  
10 state's total power requirements. California's utilities are currently purchasing little additional  
11 renewable energy. While California is likely to increase its RPS requirements to 50% by 2030,  
12 unused facilities proposed in the past would be sufficient to meet it. SunZia is thus not needed  
13 to meet the renewable energy requirements of either state.

## 14 **TOPIC 2: RELIABILITY, CONGESTION, AND TRANSFER CAPABILITY NEEDS**

15 The Applicant's statement of need regarding increasing reliability, relieving congestion,  
16 and increasing transfer capability in southwestern New Mexico and southeastern Arizona is  
17 broad and general and can be said of most any new transmission project. This statement is not  
18 tied to the specific needs of regional utilities, the future plans these utilities have for acquiring  
19 power, and how they may be addressing these concerns with their own plans. I will address  
20 these issues for southwestern New Mexico and Arizona separately.

### 21 **Southwestern New Mexico**

22 The transmission system in southwestern New Mexico is a major regional power transfer  
23 corridor known as Path 47 and is overseen and used primarily by El Paso Electric Company.  
24

1 The primary power transfer on this path is from north to south or west to east, as EPE draws  
2 power to serve users in El Paso from the Palo Verde Nuclear Generating Station in Arizona and  
3 the Four Corners Power Plant. Arizona's use of this path is restricted to small-scale power  
4 transfers from the Luna Energy Facility and Macho Springs Wind Farm by Tucson Electric  
5 Power Company.

6 Congestion on this path is measured in two ways, (1) physically in terms of power flow  
7 and the ability to meet peak load, and (2) contractually in terms of scheduling. Studies by the  
8 Western Electricity Coordinating Council show that physically this path is almost never highly  
9 utilized or congested. The path is always capable of meeting power demands. However, the  
10 path is very congested in terms of north-to-south scheduling, which has long been noted and is  
11 what SunZia references. El Paso Electric maintains tight control of the path by scheduling all or  
12 most of the capacity for itself whether that capacity is needed or not. This could potentially  
13 make it difficult for other utilities to use Path 47 for north-to-south power transfers. This raises  
14 the question, however, of whether adding capacity meets a real need.

15 Addressing this situation depends largely on how EPE intends to use Path 47 in the  
16 future. EPE's current generation plans focus entirely on building new natural gas generating  
17 capacity within El Paso and forgoing additional long-distance power transfers. EPE will  
18 abandon its interest in the Four Corner's Power Plant in 2016 and will no longer be using Path 47  
19 to deliver power from that plant, freeing up north-south transmission capacity. Public Service  
20 Company of New Mexico is doing the same with its generation, relinquishing coal-fired power  
21 plants in the Four Corners area and building new natural gas generation in and around  
22 Albuquerque and central New Mexico. Every utility has carefully assessed its own transmission  
23 system for need and reliability issues and has developed detailed ten-year plans to address any  
24

1 potential weakness in their systems. SunZia's appeal to increasing reliability is thus very  
2 general.

### 3 **Southeastern Arizona**

4 Southeastern Arizona's transmission system is much more local and does not represent a  
5 major path in the western grid. The Western Electricity Coordinating Council does not assess  
6 this part of the grid for congestion. If problems do exist, SunZia would not address them well.

7 SunZia has proposed only a single connection within southeast Arizona at Tucson Electric Power  
8 Company's 345-kilovolt lines near the proposed Willow substation. In addition, SunZia would  
9 not increase that transfer capability or reduce the scheduling congestion on TEP's lines from  
10 Willow toward Tucson.

11 The competing Southline Transmission Project would address all the same issues that  
12 SunZia says it would across southwestern New Mexico and southeastern Arizona. Southline's  
13 multiple connections with the southeastern Arizona grid would facilitate this much more  
14 effectively, providing any needed congestion and reliability relief. The Southline Project would  
15 directly and significantly increase the power transfer capability to southeastern Arizona from  
16 both central Arizona and southwestern New Mexico, whereas SunZia's single interconnection  
17 with TEP's EHV lines makes this much more difficult.

18 Arizona's utilities are also focused on building local natural gas generation to meet future  
19 needs and are not planning on acquiring or building additional large generation facilities at long  
20 distances from their service areas. The Salt River Project, for example, plans to build 2,000  
21 megawatts of new capacity in Pinal County at the Pinal Central substation and the Abel  
22 substation (Southeast Valley substation) by 2020.

1 Tucson Electric Power Company is addressing the physical limitations on its  
2 transmission system in southeast Arizona by participating in a new 500-kilovolt line between the  
3 Palo Verde Generating Station and the Pinal Central substation and by building its own 500-  
4 kilovolt line between the Pinal Central substation and Tucson. TEP is planning to access power  
5 from the northwest to meet the bulk of its future power needs.

6 **TOPIC 3: CONFLICTS WITH CENTRAL AND WESTERN ARIZONA'S**  
7 **TRANSMISSION SYSTEM**

8 SunZia's success and ability to be built depend fundamentally on sales of large blocks of  
9 New Mexico renewable energy to California. Any potential use of SunZia by Arizona's utilities  
10 would be insufficient to finance and build the project. This dependency on New Mexico power  
11 sales to California brings the project into a large-scale conflict with Arizona's future use of its  
12 own transmission system. This system was not built to facilitate large cross-state power  
13 transfers. This underlying weakness in the project's design was noted by Electrical District 4 in  
14 their 2010 Motion to Intervene in SunZia's application to the Federal Energy Regulatory  
15 Commission for a Declaratory order.

16 Financing SunZia requires the upfront sale of a minimum of 75%-80% of the project's  
17 transmission capacity, which would require power purchase agreements in the 1100-1200  
18 megawatt range for one line or 2200-2400 megawatts for two lines. Arizona utilities could not  
19 purchase the blocks of power needed to finance the project. Only Pacific Gas or Electric or  
20 Southern California Edison could, and then only if California raises its RPS to 50%.

21 At issue is how much transmission capacity is available for sale past Pinal Central to  
22 deliver New Mexico's power to California. To reach the California market, the power must be  
23 delivered to the Palo Verde hub west of Phoenix through the transmission lines built to serve  
24

1 metro Phoenix and Tucson. Much of that available transmission capacity is owned by the Salt  
2 River Project. While available capacity west of Pinal Central is currently quite large, when  
3 future uses by Arizona utilities are considered, the capacity for sale to California utilities would  
4 not accommodate two SunZia lines. SRP's plans to build an 1150-megawatt natural gas power  
5 plant at Pinal Central exacerbate the problem. SRP must reserve sufficient capacity on its new  
6 lines out of Pinal Central for the full output of this plant.

7 Also at issue is the transmission capacity in western Arizona between the Palo Verde hub  
8 and California. APS's new 500-kilovolt transmission line to Yuma has added significant new  
9 capacity, and the proposed Delaney to Colorado River line to the north would also. This  
10 capacity is vital for delivering New Mexico's power to California at the level needed to finance  
11 SunZia. However, that capacity is also vital to delivering Arizona's renewable energy to  
12 California and to meet other needs, and therein lies the conflict. Every megawatt of capacity  
13 proffered to New Mexico removes that much capacity from Arizona's use and diminishes our  
14 own economic development.

15 Avoiding these conflicts would require building a dedicated line from Pinal Central to the  
16 Palo Verde hub for New Mexico power sales coupled with arrangements with California utilities  
17 to add additional transmission capacity in western Arizona. Currently these utilities must  
18 commandeer Arizona transmission capacity built for our own use and development.

#### 19 **TOPIC 4: CONFLICTS WITH ARIZONA'S SOLAR ENERGY DEVELOPMENT**

20 Intertwined with Topic 3 is the conflict this project presents with Arizona's solar energy  
21 development in central and western Arizona and Arizona's plans to export large amounts of  
22 renewable energy to California. The richest solar resource in the nation exists here. As noted  
23 above, every megawatt of New Mexico power delivered through Arizona's transmission system  
24

1 to California diminishes the capacity of the system for our own use, not only for exporting  
2 renewable energy to California but conventional energy as well, which California also seeks.

3 As noted previously, nearly 16,500 megawatts of solar energy capacity was proposed in  
4 mostly central and western Arizona in the BLM's Solar PEIS for delivery to predominantly  
5 California. Arizona would need all of the capacity that New Mexico wishes to use to develop  
6 this potential resource. In addition, through 2010, Arizona's utilities had received nearly 15,000  
7 megawatts of solar energy interconnection requests mostly in central and western Arizona, also  
8 aimed at the California market. Through 2011, the 500-kilovolt line recently built to link Pinal  
9 Central to the Palo Verde hub had received Statements of Interest for the use of more than the  
10 line's capacity for Arizona renewable energy development.

11 As formulated, the project is incompletely conceived and does not address this in-state  
12 transmission conflict. SunZia's use of Arizona's transmission system to complete delivery of  
13 large blocks of New Mexico's power to California would damage Arizona's own renewable  
14 energy development.

15 **TOPIC 5: CONFLICTS WITH THE PLANNED SOUTHLINE TRANSMISSION**  
16 **PROJECT**

17 SunZia and the Southline Transmission Project essentially parallel one another from Las  
18 Cruces to north of Tucson and would perform the same physical function over that distance. The  
19 repetition of function across this region is a major concern. The statements of need and purpose  
20 for both projects across this region are nearly identical, with both appealing to increasing  
21 reliability and transfer capacity across this region, reducing congestion, and increasing the  
22 potential for solar development. Attempting to build both projects simultaneously would result  
23  
24

1 in an excess of transmission capacity that could not be readily used, would be wasteful of  
2 financial resources, and would unnecessarily compound environmental impacts.

3 In comparison to SunZia, the Southline Project follows existing transmission corridors  
4 much more closely and does not impact the sensitive environmental resources of the San Pedro  
5 Valley. In addition, the project's numerous interconnections with the southeastern Arizona grid  
6 make it much better suited to meet southeastern Arizona needs. Because of SunZia's single grid  
7 connection in Arizona, the project is poorly suited to accommodate future southeast Arizona  
8 power needs.

9 The fundamental difference between the two projects is that the Southline Project has  
10 about one-third the capacity and does not extend to the wind-generation area of central New  
11 Mexico. The project is composed of (1) a 240-mile-long new-build section in southwestern New  
12 Mexico and easternmost Arizona consisting of two 345-kilovolt lines, and (2) a rebuild section  
13 from the Willcox Playa to north of Tucson consisting of two 230-kilovolt lines. For the rebuilt  
14 section Southline is partnering with the Western Area Power Administration to replace and  
15 upgrade an existing 115-kilovolt line, increasing the likelihood that the project will be built.

16 A potentially relevant issue is that SunZia is now required to bury three segments of the  
17 project for a total of 5.5 miles across the Northern Call-up Area of the White Sands Missile  
18 Range. This would increase the cost of that segment of project from ~\$11 million to ~\$500  
19 million and add great technical complexity to it, making completion of that portion considerably  
20 less feasible. Without being able to complete that portion of the project, SunZia would do little  
21 more than duplicate Southline's function but with far less benefit to southeastern Arizona and  
22 with far greater environmental impacts.

1 **TOPIC 6: MEETING JOB NEEDS – SUNZIA’S ACTUAL POTENTIAL**

2 The Application greatly overstates SunZia’s job potential, which results from three  
3 fundamental misunderstandings of the economic study undertaken for the project. The project’s  
4 primary author, Alberta Charney, noted the most important issue herself in a 2011 interview with  
5 the *Albuquerque Journal*: These are job-years or man-years of work, not jobs, accumulated over  
6 four years, the period she chose to construct the project, and they are global, not confined to  
7 Arizona. Using Dr. Charney’s analysis, the *global* employment over these four years for the  
8 entire project would average 625.

9 Two other factors greatly accentuate the number. The number of construction jobs given  
10 by the Environmental Planning Group in the EIS to build both lines and both components of the  
11 four substations is 837. Of this number, 265 people would work on the Arizona portion (Arizona  
12 has only one substation). Of these 265 people, only 30% would be hired in Arizona. Seventy  
13 percent would be brought in from out of state. Thus by EPG’s job assessment, SunZia would  
14 hire about 80 people in Arizona to construct the project.

15 A third factor that inflates the results is that the total job-years of work include all work  
16 needed to acquire and manufacture the materials required to build the project, mostly the steel  
17 transmission towers and cable, neither of which is made in Arizona. Dr. Charney includes all of  
18 the job-years of work involved in producing materials for the Arizona portion of the project in  
19 the Arizona total without stating that these job-years are not associated with Arizona workers.

20 The final component of the economic analysis involves calculating how many jobs are  
21 created by the spending of wages (induced jobs). Dr. Charney uses a multiplier of 77% to assess  
22 these for Arizona. Assuming 10 miscellaneous materials jobs (the actual number is not given)  
23 and using this multiplier would give an Arizona job total of 302 (80 + 10 + 212).

24

1                                   **PROPOSED SUMMARY TESTMONY OF MICK MEADER**

2                                   **FOR POINT OF INTEREST W#3 OF THE WILLCOX AREA TOUR**

3                                   If permitted, I would testify at this point of interest about the cultural (archaeological)  
4 resources of the lower San Pedro Valley and the sites that would be impacted at SunZia's San  
5 Pedro River crossing.

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13                                   **SUMMARY TESTMONY OF BARBARA CLARK, WITNESS FOR MICK MEADER**  
14                                   **FOR POINT OF INTEREST W#3 OF THE WILLCOX AREA TOUR**

15                                   Barbara Clark is a San Pedro Valley resident of 45 years and helps manage The Nature  
16 Conservancy's Three Links Farm just north of SunZia's San Pedro River crossing. She is locally  
17 known for operating the Clayworks, a pottery-making facility that she began with others when  
18 she first arrived in the valley in 1970. She is former Chair of the Redington Natural Resource  
19 Conservation District and current Chair of the Board of Directors of the Cascabel Community  
20 Center. She has long been active in valley conservation and has been an active member of the  
21 Cascabel Conservation Association.

22                                   Barbara would testify about The Nature Conservancy's acquisition of the 2,156-acre  
23 Three Links Farm in 2002 and the importance of the farm in conserving the San Pedro River.  
24

1 The farm extends southward to within a half-mile of the SunZia crossing. The section of the  
2 river that the farm encompasses has perennial stream flow with lush riparian vegetation,  
3 including critical habitat for the southwest willow flycatcher and yellow-billed cuckoo, making it  
4 one of the most valuable conservation properties on the river. The Bureau of Reclamation holds  
5 a conservation easement on 300 acres of the farm as mitigation for impacts caused by the Central  
6 Arizona Project.

7  
8 **SUMMARY TESTMONY OF SCOTT WILBOR, WITNESS FOR MICK MEADER**  
9 **FOR POINT OF INTEREST W#4 OF THE WILLCOX AREA TOUR**

10 Scott Wilbor has been active in southern Arizona conservation for 15 years, serving as a  
11 conservation biologist with the Tucson Audubon Society from 2000–2011. He established and  
12 ran the National Audubon Society’s Important Bird Area (IBA) program for Arizona and  
13 obtained Global IBA status for the lower San Pedro River. Wilbor is a 2014 graduate of the  
14 University of Arizona’s School of Natural Resources and the Environment, where he completed  
15 his M.S. on “An ecosystem conservation assessment of the lower San Pedro watershed in  
16 Arizona” He holds prior degrees in wildlife biology and has worked in the lower San Pedro  
17 Valley with the Natural Resource Conservation Districts; corporate and federal agency resource  
18 holders; and The Nature Conservancy.

19 Mr. Wilbor would testify about the conservation holdings and linkages near the  
20 confluence of the San Pedro River with Hot Springs and Paige Canyons, where the tour will stop.  
21 This confluence occurs immediately south of the Cascabel Community Center. These holdings  
22 include deeded lands held by the Cascabel Conservation Association and the Saguro-Juniper  
23 Corporation; BLM conservation lands along the river acquired in the 1990s; Nature Conservancy  
24 conservation easements and deeded land in the Hot Springs corridor; lands on the west side of

1 the river managed by Pima County at part of their A-7 Ranch; and conservation easements held  
2 by the Arizona Game and Fish Department. Mr. Wilbor would also briefly discuss the  
3 prominent wildlife linkage between the Galiluro Mountains and Rincon Mountains that passes  
4 through Cascabel.

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## CURRICULUM VITAE

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### EDUCATION

- 9/89 to 5/94 Ph.D. candidate in tectonics, University of Arizona, Tucson, GPA 4.00. I met all requirements for the degree except completion of the dissertation. Dissertation title: *The Geology, Structure, and Uplift History of the Pinaleno Mountains, Southeastern Arizona.*
- 6/78 to 6/85 Numerous oil industry courses in geology and geophysics, Oklahoma City, Oklahoma, and Littleton, Colorado.
- 6/77 to 5/78 Cities Service Exploration Training Program (mostly in geophysics), Tulsa, Oklahoma.
- 1/75 to 5/77 M.S. in Geosciences, University of Arizona, Tucson, GPA 4.00. Thesis title: *Paleoenvironments and Paleoecology of the Upper Devonian Martin Formation Near Roosevelt Lake, Gila County, Arizona.*
- 9/69 to 5/73 B.A. in Geology, University of Northern Iowa, Cedar Falls, GPA 3.36.

### PROFESSIONAL EXPERIENCE

- 7/10 to pres. Retired
- 7/09 to 6/10 Head Administrative Assistant, Department of Geosciences, University of Arizona (half time)
- 8/08 to 6/09 Head Administrative Assistant, Department of Geosciences, University of Arizona
- 7/01 to 7/08 Administrative Associate, Geophysics Program (principally) Department of Geosciences, University of Arizona
- 3/99 to 6/01 Office Specialist Senior, Geophysics Program (principally), Department of Geosciences, University of Arizona.
- 7/90 to 3/99 Word Processing Specialist, Geophysics Program, Department of Geosciences, University of Arizona.
- 8/87 to 7/90 Secretary, Geophysics Program, Department of Geosciences, University of Arizona, Tucson.
- 2/86 to 2/87 Word Processor, Electronic Mail Technician, and Spreadsheet Programmer, Mountain States Mineral Enterprises, Inc., Tucson, Arizona.

- 7/82 to 6/85 Geophysicist, Marathon Oil Company, Denver Research Center, Littleton, Colorado. Primary duties were interpretation of seismic reflection profiles to evaluate oil prospects for international oil exploration.
- 9/81 to 4/82 Consulting Geologist (with Robert Scarborough), Tucson, Arizona. Primary duties were geologic field mapping in Arizona for a small oil exploration company.
- 6/78 to 5/81 Geophysicist, Cities Service Oil Company, Oklahoma City, Oklahoma. Primary duties were interpretation of seismic reflection profiles in Oklahoma and Kansas to determine drilling locations.
- 6/77 to 5/78 Exploration Trainee in geophysics, Cities Service Oil Company, Tulsa, Oklahoma.
- 6/76 to 8/76 Summer Geologist, Cities Service Oil Company, Exploration and Production Group, Houston, Texas. Primary duties were well log correlation, interpretation, and subsurface structural mapping.
- 9/72 to 5/76 Various positions as an undergraduate and graduate student, including: Research Assistant in Paleontology at the University of Northern Iowa, Paleontological and Archaeological Surveyor with the University of Iowa, Lab Assistant in Geochronology at the University of Arizona, Geology Summer Assistant at the Museum of Northern Arizona, and Graduate Teaching Assistant for paleontology and micropaleontology at the University of Arizona.

## **PROFESSIONAL MEMBERSHIPS**

American Geophysical Union (AGU) and the Arizona Geological Society (AGS).

## **HONORS**

Graduated with honors, University of Northern Iowa, May 1973. Charter member of chapter Gamma Sigma, Sigma Gamma Epsilon, earth science honorary, University of Northern Iowa. Scholarship for thesis work, Union Oil Company Foundation, University of Arizona, spring 1976. Honors student, University of Arizona, fall 1988 and spring 1989. Funded for dissertation field work by Chevron Oil Company, 1989. College of Science Staff Recognition Award (Geosciences), 1996. College of Science Staff Recognition Award (Geosciences), 2001. Finalist, University of Arizona Staff Award for Excellence, 2001, 2002. College of Science Staff Advisory Council UA Star Award, 2009. College of Science Staff Recognition Award (Geosciences), 2010.