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UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

In The Matter Of:	)	Docket No. 40-7580 – MLA
	)	
FANSTEEL, INC.,	)	Re: Request To Amend Source
Muskogee, Oklahoma	)	License No. SMB-911
	)	

FANSTEEL, INC.'S ANSWER IN OPPOSITION TO THE REQUEST FOR HEARING FILED BY THE STATE OF OKLAHOMA

I. INTRODUCTION

Fansteel, Inc. ("Fansteel") holds source materials license SMB-911, which authorizes it to possess natural uranium and natural thorium present in process residues and as a contaminant in soils and sediments at its facility in Muskogee, Oklahoma (the "Fansteel Site" or "Site"). The license authorizes Fansteel to process the residues into commercial products[1] (License Amendment # 1, dated December 18, 1997, and License Amendment # 5, dated March 25, 1997), and Fansteel has requested a license amendment to authorize site decommissioning, which will address the radioactive contaminants in soils and sediments.

In support of its license amendment request, Fansteel submitted a Decommissioning Plan ("DP"), wherein it indicated that it would decommission over 90 percent of the Fansteel Site for unrestricted release in accordance with NRC's Site Decommissioning Management Plan ("SDMP") criteria. This would be accomplished by consolidating and

[1] Fansteel will produce tantalum and uranium concentrates, scandium oxide, cryolite and sodium sulfate from the residues.

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stabilizing the contaminated soils in an engineered containment cell located on a discrete portion of the site. The containment cell would be decommissioned in accordance with the NRC's criteria for license termination under restricted conditions, 10 CFR § 1403.

At the NRC's request, Fansteel prepared separate DPs for the unrestricted and restricted release programs. *See* Memorandum dated April 16, 1999 from Michael E. Adjodha, Licensing Section, Licensing and International Safeguards Branch, Division of Fuel Cycle Safety and Safeguards, NMSS, to Theodore S. Sherr, Chief, Licensing and International Safeguards Branch, Subject: Summary of Fansteel Meeting. After preparing an Environmental Assessment and Finding of No Significant Impact ("FONSI"), and providing opportunity for a hearing (none was requested), NRC approved the unrestricted release DP. *See* August 20, 1999 letter from T. Sherr to J. Hunter and License Amendment # 6, dated August 20, 1999. The NRC has yet to commence the technical review or environmental review of the Restricted Release DP ("RRDP"), but it published a Notice of Consideration of Amendment Request For Construction of a Containment Cell at Fansteel Facility in Muskogee, Oklahoma and Opportunity for Hearing. 64 Fed. Reg. 49823 (Sept. 14, 1999).

On October 14, 1999, the Oklahoma Attorney General, on behalf of the State of Oklahoma, filed a Request for Hearing ("Request") pursuant to 10 CFR § 2.1205. Fansteel hereby files its Answer in Opposition to the Request.

As demonstrated in this Answer, the Request does not meet the requirements of 10 CFR §§ 1205(e) and (h). The Request does not meet the applicable standards for standing because it fails to explain how approval of the RRDP will cause the alleged injuries to Oklahoma's interests or how a favorable decision would redress the alleged injuries to those interests. Additionally, the Request fails to identify any issue germane to the proceeding.

II. BACKGROUND

Fansteel's Muskogee facility was a rare metals extraction plant that produced tantalum metal and columbium oxide from 1958 until late 1989. The facility received tantalum and columbium bearing ores and slags from locations world wide and also reprocessed high purity scrap tantalum which it purchased from other tantalum users. These ores and slags also contained significant amounts of other rare metals and rare earth elements, as well as low concentrations of natural uranium and natural thorium (referred to as uranium and thorium throughout the rest of this Answer, but which is meant to include these nuclides and their decay products). *See* Remediation Assessment, Fansteel, Inc.-Muskogee, Oklahoma (1993). The uranium and thorium were not present in economically recoverable amounts, but together they exceeded the 0.05 weight percent (wt%) threshold for being classified as source material, thereby requiring the facility to be licensed by the NRC (or its predecessor, the Atomic Energy Commission). The Fansteel Facility received its first source material license, SMB-911, on January 27, 1967.

The ores and slags were physically and chemically treated to extract the tantalum and columbium. The materials were first pulverized and then digested using hydrofluoric acid. The tantalum and columbium were dissolved in the acid. The remaining residues, designated work-in-process or "WIP residues", were stored in several surface impoundments for later processing. *See* Remediation Assessment, Fansteel, Inc.-Muskogee, Oklahoma (1993). The uranium and thorium present in the original ores and slags remained in those residues at concentrations of about 0.15% each.

The tantalum and columbium were extracted from the acid solution using MIBK, an organic solvent. Subsequent chemical processing separated the columbium and tantalum and converted each into final products. *See id.* Wastewaters from these operations were neutralized with lime and collected in other surface impoundments where the neutralization products,

primarily calcium fluoride, settled, as a sludge, on the bottom of the ponds. This calcium fluoride sludge contains uranium and thorium on the order of 0.02 - 0.05 wt%.

Presently, there are about 9,600 tons of WIP residues and about 85,000 tons of calcium fluoride residues at the Fansteel Site containing about 44 curies of uranium and thorium, which is about 93% of the total activity at the Site. *See* Fansteel, Inc. License SMB-911.

Since ceasing production in 1989, Fansteel has been involved in a continuous effort directed toward final termination of operations and decontamination and decommissioning the Fansteel Site. For the first few years, Fansteel concentrated on alternatives for the WIP residues which would recover the metal values and reduce the amount of radioactivity at the Site. It explored potential sale of the residues to processing operations in Thailand, China, Hong Kong, Ecuador and Mexico. It also explored processing alternatives in the United States. Finally, Fansteel decided to process both types of residue onsite.

Fansteel has subsequently refitted its process facilities to process the entire inventory of residues on-site and received authorization from the NRC and Oklahoma to begin processing.[2] *See* License Amendment # 5, dated March 25, 1997 (for WIP material) and License Amendment # 1, dated December 18, 1997 (for CAF material). The residue processing facility is presently undergoing start-up operations. Residue processing will take 10-12 years to complete, but will reduce the radioactive inventory at the site by 93%. *See* Fansteel, Inc. License SMB-911.

As part of the residue process facility, Fansteel upgraded its wastewater treatment system. At the same time, Fansteel installed approximately 3100 feet of interception trench to collect contaminated groundwater for treatment prior to either use in residue processing or discharge to the Arkansas River. This groundwater treatment system will continue to operate

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[2] Oklahoma Department of Environmental Quality ("OKDEQ") issued NPDES Permit No. OK0001643 and Air Permit No. 94-329-C for residue processing and related operations at the Fansteel Site.

until groundwater quality meets applicable standards, which is expected to extend beyond the 10-12 years of active processing. *See* Decommissioning Plan, Fansteel, Inc.-Muskogee, Oklahoma (June, 1999).

Starting in January 1993, Fansteel began a comprehensive site characterization program directed toward identifying areas of radiological and chemical contamination and developing sufficient information about the site to evaluate remedial alternatives. The results of this study are reported in (i) Radiation Survey and Remediation Assessment - Northwest Property (July, 1993), and (ii) Remediation Assessment, Fansteel, Inc.-Muskogee, Oklahoma (December, 1993).

Fansteel subsequently evaluated various remedial alternatives and determined that onsite containment of radiologically contaminated soils and soil-like materials was the most appropriate alternative. *See* Feasibility Study, Fansteel, Inc.-Muskogee, Oklahoma (1994). That approach would enable Fansteel to economically clean-up 90% of the site to unrestricted release, whereas off site disposal would exceed Fansteel's ability to pay; thereby resulting in a lesser cleanup. The Feasibility Study also provided the technical basis for Fansteel's first DP that was submitted to the NRC in June, 1994. *See* Eastern Property Area Decommissioning Plan, Fansteel, Inc.-Muskogee, Oklahoma (June, 1994). That DP outlined a decommissioning program relying on onsite containment of contaminated soils.

Fansteel updated the DP on several occasions, each time revising it to provide additional information, to respond to comments from NRC Staff reviewers, and to reflect ongoing activities. Revised DPs were submitted in February, 1996; July, 1998; and December, 1998. The later version also included supporting documentation for the containment cell.

In March 1999, the NRC notified Fansteel of its intentions to review the DP as two separate plans – one DP addressing that portion of the site that would be decommissioned for

unrestricted release per SDMP criteria (the "URDP") and another DP for the containment cell which would be decommissioned for restricted release per 10 CFR § 20.1403, the RRDP.

On June 16, 1999, Fansteel submitted the URDP. NRC provided opportunity for a hearing (none was requested). *See* Decommissioning Plan, Fansteel, Inc.-Muskogee, Oklahoma (June, 1999). It also prepared an environmental assessment and issued a FONSI. *See* NRC Letter dated August 12, 1999 from Michael Adjodha to Fansteel, Inc.-TAC No. L31086. The NRC then approved the unrestricted release DP and amended the license accordingly.

On August 13, 1999, Fansteel submitted the RRDP, along with the updated Remedial Design Report, Treatability Study and ALARA analysis. *See* Remedial Design Report - Stabilization and Solidification of Above-Action Level Soil and Construction of Containment Cell, Fansteel, Inc. - Muskogee, Oklahoma (August, 1999); Treatability Study Report for Stabilization and Solidification of Above-Action Level Soil, Fansteel, Inc. - Muskogee, Oklahoma (August, 1999), ALARA Analysis, Section 2.1.2.7 of Decommissioning Plan, Fansteel, Inc. - Muskogee, Oklahoma (August, 1999).

The RRDP features an on-grade containment system comprised of a monolith of cement-stabilized radiologically contaminated soils and a gently sloping durable cover system designed to passively divert water, retard radon emanation, reduce radiation exposures and withstand natural phenomena of credible magnitude for at least 1,000 years. To ensure that the integrity of the containment system is not compromised, the RRDP also describes institutional controls and a financial assurance program for monitoring and maintenance that were developed with input from a series of public meetings held by a Site Specific Advisory Board ("SSAB") composed of representatives from the surrounding community.

Throughout this entire process, Oklahoma has had the opportunity to express its concerns and to protect its interests. It has been copied on all major decommissioning related correspondence between Fansteel and NRC; it has issued permits for decommissioning related

activities; it participated on the SSAB convened by Fansteel; it has inspected site operations; and it has attended meetings between Fansteel and the NRC. Notwithstanding its prior participation, and silence with regards to the plans, Oklahoma now requests a hearing on the RRDP.

III. OKLAHOMA'S REQUEST FOR HEARING SHOULD BE DENIED BECAUSE IT DOES NOT MEET THE BASIC REQUIREMENTS UNDER THE ATOMIC ENERGY ACT AND NRC REGULATIONS

A. Requirements For Requests For Hearings

According to the Atomic Energy Act ("AEA"), a hearing on an application for a license amendment will be held upon request of any person whose interest may be affected by the NRC's action on the application. AEA § 189a(1), 42 U.S.C. § 2239(a). NRC has elaborated on this requirement in its implementing regulations, 10 CFR Part 2, Subpart L--*Informal Hearing Procedures for Adjudications in Materials and Licensing Proceedings*, 10 CFR § 2.1201 *et seq.*, which applies in a proceeding for amending a materials license subject to 10 CFR Part 40, such as Fansteel's.

According to Subpart L, § 2.1205(e), a request for a hearing by a person other than the applicant must describe in detail: (1) the requestor's interest in the proceeding; (2) how that interest may be affected by the results of the proceeding, including the reasons why the requestor should be permitted a hearing, with particular reference to the factors set out in § 2.1205(h); (3) the requestor's areas of concern about the licensing activity; and (4) the timeliness of the request.

The Presiding Officer must review the request to determine that the specified areas of concern are germane to the proceeding, that the request is timely, and that the requestor meets the requirements for standing. 10 CFR § 2.1205(h). In determining whether the requestor has standing, the Presiding Officer must consider; (1) the nature of the requestor's right under the AEA to be made and party to the proceeding; (2) the nature and extent of the requestor's

property, financial or other interests in the proceeding; and (3) the possible effect of any order that might be entered in the proceeding upon the requestor's interest. *Id.*

The party requesting the hearing has the burden of demonstrating that its request should be granted. *Babcock & Wilcox* (Pennsylvania Nuclear Services Operations, Parks Township, Pennsylvania), LBP-94-4, 39 NRC 47, 48 (1994). As explained in the following sections, Oklahoma has not met this burden. Its Request fails to demonstrate that Oklahoma has standing and that the areas of concern are germane to this proceeding.

B. The Request Fails To Demonstrate That Oklahoma Has Standing To Request A Hearing

1. Requirements For Standing

The Presiding Officer must determine that the requestor meets requirements for standing. *In The Matter of Northwest Nuclear Energy Co.* ("NNECO"), (Millstone Nuclear Power Station, Unit 3), LBP-98-22, 48 NRC 149, 153-154 (1998), *Portland General Electric Co.* (Pebble Spring's Nuclear Plant, Units 1 and 2), CL1-76-27, 4 NRC 610 to 13-14 (1976). These requirements are also applicable to informal hearings held pursuant to subpart L. *Chemetron Corp.* (Bert Avenue, Harvard Avenue, McGean - Rohco Sites, Newburgh Heights and Cuyahoga Heights, Ohio), LBP-94-20, 40 NRC 17, 18 (1994).

To meet the requirements for standing, the requestor must show that it meets the following "irreducible constitutional minimum" requirements: (1) the requestor will suffer an "injury in fact" which is "concrete and particularized and ... actual or imminent, not conjectural or hypothetical"; (2) there is a causal connection between the alleged injury and the action complained of; and (3) the injury will be redressed by a favorable decision. *Bennett v. Spear*, 520 U.S. 154, 167-168 (1997), *NNECO, supra* 48 NRC at 154. All three elements must be demonstrated to establish standing. *Iberville Parish Waterworks District No. 3*, 45 F. Supp. 3d 934, 943 (S.D. Ala. 1999).

Furthermore, requestors are required to provide some form of substantiating evidence for their factual assertions. *Shieldalloy Metallurgical Corp.* (Cambridge, Ohio Facility), CL1-99-12, ____NRC _____ (1999). Moreover, in the case where a state is the requestor, NRC has recognized that "standing should not be automatic... [a] state, like any other intervenor, must demonstrate that, as a result of the amendment, its citizens or natural resources will likely suffer injury that is 'distinct and palpable, particular and concrete, as opposed to being conjectural or hypothetical." *International Uranium (USA) Corp.* (Receipt of Material from Tonawanda, New York), LBP-98-21, 48 NRC 137, 141 (1998), quoting *International Uranium (USA) Corp.* (White Mesa Uranium Mill), CL1-98-6, 47 NRC 116, 117 (1998).

2. The Request Fails To Demonstrate That Approving The RRDP Will Cause Injury In Fact To Oklahoma's Interest

Oklahoma has failed to demonstrate that an injury in fact exists for two basic reasons. First, Oklahoma's alleged injuries are too generalized and speculative to establish injury in fact. Second, given that it has failed to demonstrate the existence of a significant source of radioactivity producing an obvious potential for offsite environmental consequences, Oklahoma cannot rely upon a presumption of injury in fact based on geographical proximity.

a. Oklahoma's Alleged Injuries Are Too Generalized and Speculative

For a requestor to establish injury in fact, its alleged injuries must be "concrete and particularized," "actual or imminent," "distinct and palpable" and not merely "conjectural or hypothetical." *Bennett v. Spear*, 520 U.S. at 167-168; *Dellums v. NRC*, 863 F.2d 968, 971 (D.C. Cir. 1988); *International Uranium*, 48 NRC at 141; *NNECO*, 48 NRC at 154.

In the Request, Oklahoma alleges five different injuries. In each case, the alleged injury is either too speculative (*i.e.*, involving potential future harms arising from extremely low probability events), too generalized to be particular and concrete, or both. Moreover, there are

several instances where the description of the injury uses information about the proposed action that is either taken from the RRDP and its supporting documents and distorted, or is attributed to these sources but is just plain wrong. The alleged injuries are:

(i) The containment cell will harm the citizens, air, land, waters, wildlife and natural resources of Oklahoma, as well as the health, safety, and welfare of Oklahoma's citizens who live, work, travel, and recreate near the Fansteel facility, and who rely upon the Arkansas River for consumption, irrigation or livestock uses. Request at 17.

Oklahoma makes this broad and sweeping claim of injury based on the mere presence of radioactivity at the Fansteel Site and unfounded assumptions and wild speculation that the containment cell will fail, allowing this radioactivity to be released into the environment. This alleged injury is neither "concrete and particularized" nor "actual and imminent;" instead, it is "conjectural or hypothetical."

Oklahoma correctly states that the containment cell will contain 25,500 cubic yards of decommissioning wastes. Request at 17. The Request does not indicate how much radioactivity or the concentration of activity that will be placed in the cell. Fansteel estimates that the cement stabilized soil monolith will contain only 3.23 curies of uranium and thorium at a concentration of 82.9 pCi/g. *See* Fansteel, Inc. License SMB-911. This is much less than the 0.05 wt. % threshold for source material, (*see* 10 CFR §§ 40.4; 40.13), and is less than other wastes containing naturally occurring radioactive materials (e.g., oil and gas drilling wastes) whose disposal in Oklahoma is presently unregulated.[3] *See* Exhibits 1 and 2.

Oklahoma then alleges that the containment cell design is deficient and that a release of radioactivity from the cell to the groundwater and thence to the Arkansas River is

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[3] Personal communication between John Hunter, Fansteel, and Pamela Bishop, OKDEQ - Waste Management Division.

"inevitable." Request at 17. Oklahoma alleges that design is deficient because (1) the cell will be built on native soils and will not have a liner or a leachate collection system; and (2) the combination of the cell cap and the cement stabilized waste form will not prevent generation of radioactive leachate. *Id.* Both alleged deficiencies are baseless, as they either ignore or distort the cell design information that Fansteel submitted to the NRC. *See* Decommissioning Plan, Fansteel, Inc. - Muskogee, Oklahoma (August, 1999); Remedial Design Report - Stabilization and Solidification of Above-Action Level Soil and Construction of Containment Cell, Fansteel, Inc., - Muskogee, Oklahoma (August, 1999); Treatability Study Report for Stabilization and Solidification of Above-Action Level Soil, Fansteel, Inc., - Muskogee, Oklahoma (August, 1999).

First, the cell will not be built directly on native soils. The existing subgrade will be regraded so that drainage is provided toward the east. Use of in-place soils is anticipated. This includes "slough" material from the southeast corner of the monolith, where the existing slope will be regraded to a more uniform configuration. The bottom monolith surface (subgrade) will be scarified and compacted (proof-rolled) to provide a stable foundation. Compaction will meet or exceed 90 percent of the Modified Proctor maximum density. Where in-place density tests show that the minimum compaction is not achieved, the non-complying area will be reworked until the compaction requirement is met. Reworking may include scarifying and rerolling, or overexcavation of the material. Where overexcavation occurs, suitable replacement material will be placed in maximum nine inch loose lifts and compacted until the minimum criteria are demonstrated. *See* Remedial Design Report - Stabilization and Solidification of Above-Action Level Soil and Construction of Containment Cell Appendix C, Fansteel, Inc. - Muskogee, Oklahoma (August, 1999).

Second, the cell will not have a leachate collection system per se because design analysis indicates that none is required.[4] The radioactive contaminated soils will be stabilized with

[4] Fansteel has already installed a groundwater interceptor trench downgradient from the cell and existing sources of contamination. This trench will be operated until groundwater under the

cement to form a leach resistant monolith. Fansteel has demonstrated the leach resistance of the waste form using NRC prescribed test methods that are far more aggressive than what could be encountered in nature. These methods were not designed to predict if, or when, radioactive leachate would form in the cell. *See* Treatability Study Report for Stabilization and Solidification of Above-Action Level soil, Fansteel, Inc.-Muskogee, Oklahoma (August 1999).

Oklahoma incorrectly interprets and applies Fansteel's hydrological evaluation and its leachability testing to develop an implausible release scenario. Oklahoma makes repeated reference to the figure 25,850 ft.^{3} of water that will "leak through the bottom of the disposal cell." Request at 17, n.11. Oklahoma's representation of these statements is misleading. The 28,850 ft.^{3} of "leakage" is the average annual percolation over a 6-acre area. This equates to a flow of only 0.4 gallons per minute, or 0.0000038 gallons per minute per square foot. Although this amount of liquid would readily be absorbed in subgrade soils before reaching groundwater, *assuming* that it does reach groundwater, and *further assuming* that it passes the interceptor trench, the leachate would encounter the average 8,700,000 gallon per minute flow of the Arkansas River adjacent to the site where it would be imperceptible. Thus, a release of radioactivity from the cell to the groundwater and the Arkansas River is hardly "inevitable" as Oklahoma alleges. Rather, this is the "hypothetical and conjectural" harm that does not constitute injury in fact.

Oklahoma next alleges that the cell will be placed over test boring locations and monitoring wells, providing a virtual "super highway" for contaminants to reach groundwater. Request at 18. This is more hyperbole than fact. The borings and monitoring wells either have been or will be sealed in accordance with accepted industry practice and Oklahoma's regulatory

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site meets applicable drinking water criteria, which is anticipated to be beyond the time when the cell is completed and closed. *See* License Amendment # 6, dated August 20, 1999. *Assuming* that the cell design is deficient, any leachate would be collected in this system.

requirements.[5] This will preclude a preferential pathway to groundwater. As described above, however, even if there was a pathway, the volume of water that would enter it would only be 0.0000038 gallons per minute per square foot (assuming the bore hole covers one square foot). Moreover, leachability studies indicate that the radiological content of that water would be extremely low. Again, the "allegation" is "hypothetical and conjectural" rather than being "actual or imminent."

Oklahoma also characterizes Fansteel's proposed long-term maintenance budget as "inadequate" and alleges that this will amplify and accelerate this contamination process by not providing any realistic amount of money for maintenance and repair of the disposal cell, or for remediation of groundwater contamination caused by the disposal cell. Request at 18. This is a conclusory statement that is too general to constitute injury in fact. Oklahoma does not explain why the maintenance budget is inadequate, especially in light of the robust cell design. Furthermore, it is wrong. Fansteel's decommissioning funding plan cost estimating table presented in the RRDP (Exhibit 9 in the Request) provides annual costs for activities such as groundwater monitoring, fence repair, and cell cover repair. Fansteel's financial assurance fund was specifically designed to generate sufficient annual income to pay for these maintenance costs without having to invade the principal in the fund. *See* Table 3 of Decommissioning Plan, Fansteel, Inc. - Muskogee, Oklahoma (August, 1999).

Oklahoma further alleges that the RRDP wholly fails to account for migration of the Arkansas River into the Fansteel facility and the catastrophic failure of the disposal cell under these circumstances. Request at 18-19. This is yet another example of pure conjecture. Oklahoma does not identify a mechanism by which the Arkansas River could migrate into the

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[5] Oklahoma Water Resources Board Rule 35-11-2(a) provides closure requirements for wells and borings that ensure that they are sealed in a manner that actually reduces the permeability of the in-place materials, thereby eliminating the likelihood of groundwater contamination.

containment cell, nor does it explain how that could cause "catastrophic failure" of the cell, or what the resulting harm would be. To disguise its conjecture, Oklahoma offers a map of unconsolidated alluvium and terrace deposits (Request Exhibit 5) and a figure showing various courses of the Mississippi River (Request Exhibit 6). Oklahoma explains that the alluvium and terrace deposits, which underlie the Fansteel site, reflect historic pathways of the Arkansas River. Request at 40 n.26. What Oklahoma does not explain is how the historic pathway would be a future pathway (assuming that such deposits truly represent the historic pathways of the Arkansas River), how the river course would change given the fact that there are 25 dams controlling flow along its course, or how the river would migrate considering that its current course is cut into the bedrock adjacent to the Fansteel site. Alluvial deposits found on the Fansteel property are the direct result of higher water levels which resulted from glacial meltwaters draining into Oklahoma from retreating glaciers located outside of Oklahoma in Colorado during the end of the last ice age approximately 11,000 years ago. Oklahoma's references to the migration of the Mississippi River (Request at 40 and Exhibit 5) and the Red River (Request at 40) are totally irrelevant to this proceeding and should be stricken from the record. These rivers are at least 130 and 280 miles, respectively, from the site, and Oklahoma has failed to explain how they relate to the site.

Finally, in addition to the speculative nature of this alleged injury, it is also too general to constitute injury in fact. For example, Oklahoma does not identify any specific users of the Arkansas River who use it for consumption, irrigation, or livestock, nor does it identify where such users are located or their downstream distance from the Fansteel site. Furthermore, the Request does not specifically describe the levels of alleged radiological releases or the likelihood of these releases. Also, the Request does not demonstrate that releases from the cell would exceed NRC's regulatory limits within the 1000 year timeframe specified in the regulations. 10 CFR §§ 20.1401(d); 20.1403(c)(e). Without a basis for concluding that release levels would exceed NRC regulatory limits, there is no harm that can be redressed.

(ii) The Inadequate Long-Term Maintenance and Monitoring Budget Proposed by Fansteel in the Restricted Release DP Will Amplify and Accelerate Releases of Radioactive Contaminants into the Air of Oklahoma. Request at 19.

Oklahoma alleges injury in fact because the containment cell cap is designed only to reduce air emissions of radioactive contaminants (Request at 20); the financial assurance for long-term monitoring does not include adequate or realistic funding for maintenance and repair of the containment cell cap *(Id.)*; and that there is no budget for air monitoring *(Id.)*. These allegations also suffer from a lack of specificity. Oklahoma does not indicate any level of radioactive emissions from the cell, and it does not allege that radiological emissions [radon] would exceed regulatory limits.

While minor radiological exposures resulting from proposed licensed activity are sufficient to create injury in fact, *Atlas Corporation* (Moab, Utah Facility) LBP-97-9, 45 NRC 414, 425 (1997), Oklahoma does not describe how these unquantified air emissions would result in any radiological exposures, considering that institutional controls will be established to prevent human intrusion into the cell. *See* Decommissioning Plan, Fansteel, Inc. - Muskogee, Oklahoma (August, 1999). Fansteel has proposed a long-term maintenance fund for the site, but Oklahoma alleges that the funds for cell cover maintenance are inadequate. Oklahoma does not explain why the funds are inadequate, and it does not describe what an adequate maintenance program or an adequate level of funding might be. Finally, Oklahoma alleges that the maintenance fund does not include monitoring, but it does not explain why monitoring would be necessary or what harm monitoring would prevent.

(iii) The Placement of Radioactive Waste in Proximity to the Arkansas River Will Lessen the Recreational Value of the River Causing Tourism to Decrease and a Corresponding Decrease in Tourism and Related Revenues. Request at 20.

Oklahoma alleges that because of the "nearby wildlife refuges, such as the Webbers Falls Unit of the McClellan-Kerr Wildlife Refuge and the Cherokee Gruber Wildlife Refuge" that the area is an important tourism asset and is frequented by its citizens for recreational purposes, and that approval of the RRDP will lessen tourism and the associated revenues. *Id.* These allegations are more generalization and speculation. First, Oklahoma does not specify where these refuges are in relation to the Fansteel site or their distance from it. Oklahoma also does not specify the current level of tourism and recreational use of the area around the site, nor the current level of revenue generated from these activities. Furthermore, Oklahoma does not indicate how approval of the RRDP would reduce tourism and recreation in the area to cause the alleged harm.

(iv) The Restricted Portion of the Fansteel Site Will be Barred From All Future Use. Request at 21.

Oklahoma alleges that approval of the RRDP will result in removal of 6-12 acres of the Fansteel site from all future use and that the mere presence of the containment cell will reduce the market value of surrounding property and will lower ad valorem tax revenues for Oklahoma. *Id.* These allegations are lacking in specificity and are hypothetical and conjectural. Oklahoma indicates that the Fansteel site has a current appraised value of over $2,700,000 and pays nearly $30,000 per year in property taxes. *Id.* at footnote 21. Oklahoma does not explain how the appraised value and property taxes would be lessened, especially when approximately 56 acres of the site will be decommissioned for unrestricted release (in addition to the 35 acres already released for unrestricted use). Oklahoma also fails to explain how surrounding property values would be reduced by approval of the RRDP, especially in light of the current uncontained

radioactive materials at the Fansteel site. Finally, Oklahoma ignores the potential for increased property values and tax revenues that may be realized by decontaminating the balance of the Fansteel site for unrestricted use. This alleged injury is entirely too general and too hypothetical to constitute injury in fact.

(v) **Releases of Radioactivity From the Disposal Cell will Require Remediation Requiring the Use of Heavy Vehicles that Will Injure the Roads and Possibly Force the Shutdown or Relocation of Roads Near the Fansteel Site.** Request at 22.

Oklahoma alleges that the approval of the RRDP will cause injury in fact to roads and thoroughfares owned, operated and maintained by Oklahoma because inevitable releases from the containment cell will require major remediation, involving the use of heavy equipment and trucks on those roads and thoroughfares.[6] *Id.* This allegation is based on implausible scenarios and lacks the necessary specificity to be injury in fact.

Oklahoma does not indicate what type of releases will inevitably occur or why such releases would require major remediation involving use of heavy equipment. Oklahoma does not allege that the use of heavy equipment and trucks on the affected roads and thoroughfares would be contrary to applicable law, or that weight limits on affected roads and thoroughfares would be exceeded in the event of major remediation. Accordingly, Oklahoma fails to state a concrete injury in fact to its roads and thoroughfares from the use of heavy equipment as a result of unspecified releases from the proposed disposal cell.

In trying to allege a specific injury, Oklahoma postulates a catastrophic failure of the containment cell due to extremely unlikely natural phenomena, but in doing so, it ignores the fact that the cell has been designed to withstand such events. The cell was specifically designed to

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[6] Oklahoma is apparently unconcerned about the heavy equipment and trucks loaded with contaminated soils that would travel its roads if the RRDP was rejected and the entire Fansteel site was decommissioned for unrestricted release.

withstand credible maximum floods and earthquakes. *See* Remedial Design Report - Stabilization and Solidification of Above-Action Level Soil and Construction of Containment Cell, Fansteel Inc. - Muskogee, Oklahoma (August, 1999). Furthermore, the Request fails to describe any mechanism, much less a credible one, by which either a tornado would cause a release from the cell, [7] or the Arkansas River would migrate from its bedrock channel onto the site, inundate the cell and cause a catastrophic failure of the cell.

Oklahoma also alleges that its interest in nearby State Highway 165 would be injured by inevitable releases from the disposal cell, which could force Oklahoma to shut down or permanently move this roadway to avoid radioactive contamination. Request at 22. This allegation also lacks the requisite specificity. Oklahoma does not indicate what type of release will occur from the cell or provide sufficient information to indicate why such a release could injury Highway 165. Accordingly, Oklahoma does not state an injury in fact.

In summary, Oklahoma has failed to identify injury in fact. Each of the alleged injuries is entirely too general and too hypothetical to constitute injury in fact. To attempt to show injury to its interests, Oklahoma either merely alleges that releases of radioactivity will occur from the containment cell or postulates incredible scenarios by which releases would occur. In either case, Oklahoma fails to identify how much radioactivity would be released, how it would be transported away from the site, how it could harm any of Oklahoma's interests or to what degree its interests would be harmed over maintaining the status quo or remediating the Fansteel Site for unrestricted release. Oklahoma provides no factual basis for its alleged injuries. Such general assertions of offsite releases or economic injury must be supported by factual statements.

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[7] The containment cell will be built at the location of a soil borrow pit that was created when the process lagoons were originally constructed. When completed, the final elevation of the cell will extend above original grade by about two feet. *See* Remedial Design Report - Stabilization and Solidification of Above-Action Level Soil and Construction of Containment Cell, Fansteel, Inc. - Muskogee, Oklahoma (August, 1999). Considering this protective topography, it is incredible to assume that either a tornado or a flood could cause catastrophic failure of the cell.

Hydro Resources Inc. (2929 Coors Road, Suite 101, Albuquerque, NM 87120), LBP-98-9, 47 NRC 261, 273 (1998); *Babcock and Wilcox* (Apollo, Pennsylvania Fuel Fabrication Facility), LBP-93-4, 37 NRC 72, 95 (1993). In each case, the specific factual support is missing and the allegations fail to demonstrate a concrete, palpable, distinct and particularized injury in fact requisite for standing.[8]

b. Oklahoma May Not Rely Upon A Presumption of Injury In Fact Given the Lack of a Significant Source of Radioactivity Producing an Obvious Potential for Offsite Environmental Consequences

Recognizing its failure to establish injury in fact, Oklahoma attempts to rely on a presumption of injury based on geographic proximity. Request at 14-16. A presumption of injury in fact for standing based on geographic proximity may be applied in non power reactor cases where the proposed action involves a significant source of radioactivity producing an obvious potential for offsite consequences. *Georgia Institute of Technology* (Georgia Tech Research

[8] Oklahoma has also failed to establish that all of its alleged injuries fall within the "zone of interests" of the statutes governing NRC proceedings, namely, the AEA and the National Environmental Policy Act ("NEPA"). *NNECO*, 48 NRC at 154. For example, Oklahoma alleges that its economic interests will be adversely affected because the proposed containment cell will damage Oklahoma's interests in the scenic beauty, recreational value and ecology of its natural resources, specifically the Arkansas River, the Webbers Falls Unit of the McClellan-Kerr Wildlife Refuge, and the Cherokee Gruber Wildlife Refuge, and thus have a negative impact on tourism, which generates tax revenues. However, Oklahoma cites no authority to demonstrate that its tax revenues constitute an interest protected by the AEA or the NEPA. Such interests are akin to taxpayer interests, which are not protected. *Tennessee Valley Authority* (Watts Bar Nuclear Plant, Units 1 and 2), ALAB-413, 5 NRC 1418, 1421 (1977) and *Northern States Power Co.* (Pathfinder Atomic Plant), LBP-89-30, 30 NRC 311, 315 (1989).

In addition, Oklahoma does not identify how its interests fall within the zone of interest of NEPA. NEPA imposes procedural rather than substantive constraints on an agency's decision making process, requiring only that the agency undertake an appropriate assessment of the environmental impacts of its action without it being mandatory that the agency reach any particular result concerning that action. *In the Matter of Babcock and Wilcox*, (Apollo, Pennsylvania Fuel Fabrication Facility), LBP-93-4, 37 NRC 72, 93 (1993). Oklahoma has not alleged any injury to its procedural rights under NEPA--nor can it at this time because NRC has not yet begun its review of the RRDP.

Reactor), CLI-95-12, 42 NRC 111, 116 (1995), *citing Sequoyah Fuels Corp.* (Gore, Oklahoma Site), CLI-94-12, 40 NRC 64, 75 n.22 (1994). However, in order for a petitioner to avail itself of the presumption, the license amendment at issue must present an obvious potential for offsite consequences. *NNECO, supra* at 154-155, *quoting Florida Power & Light Co.* (St. Lucie Nuclear Power Plant, Units 1 and 2), CLI-89-21, 30 NRC 325, 330 (1989). Here, Oklahoma alleges that the containment cell proposed by Fansteel involves a significant source of radioactivity by providing information about the cell's design dimensions and volume (Request at n.10, pp. 15-16), but it provides absolutely no information on the radiological content of the cell. Thus, it has not demonstrated that the cell will be a "significant source" of radioactivity.[9]

Furthermore, Oklahoma attempts to circumvent the requirement that there be an "obvious" potential for offsite harm from the proposed action. It ignores the fact that the amount of activity to be contained is only a small fraction of that already present and authorized at the site, and merely alleges harm in the vicinity of the site without pointing to specific citizens or describing a mechanism of injury, factors the NRC has found important to show injury in fact. *In the Matter of International Uranium, supra*, 48 NRC at 146.

Because Oklahoma cannot identify a plausible mechanism by which the containment cell would impact either health and safety or the offsite environment in the proximity of the cell, it is not entitled to a presumption of injury.

3. Oklahoma Has Failed To Demonstrate That Its Alleged Injury Would Be Caused By NRC Approval Of The RRDP

In a proceeding involving a materials license, "a petitioner who wants to establish 'injury in fact' for standing purposes must make some specific showing outlining how the

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[9] When completed, the cell will contain only 3.23 curies of uranium and thorium at a concentration of only about 82.9 pCi/g (0.017 wt%), which is below the 0.05 wt% threshold for regulated source material *See* AEA, 42 U.S.C. § 2014(2) and 10 CFR § 40.4.

particular radiological (or other cognizable) impacts from the . . . materials involved in the licensing action at issue can reasonably be assumed to accrue to the petitioner." *Atlas Corp.* (Moab, Utah Facility), LBP-97-9, 45 NRC 414, 426 (1997), *citing Yankee Atomic Electric Co.* (Yankee Nuclear Power Station), CLI-96-7, 43 NRC 235, 247-48 (1966). This requires the requestor to provide some plausible claim of causation to show how the particular license amendment would result in a distinct harm or threat to him. *Commonwealth Edison Co.* (Zion Nuclear Power Station, Units 1 and 2), CLI-99-4, 49 NRC 185, 191 (1999). As described in the previous section, Oklahoma's alleged injuries are so general and conjectural that they cannot constitute injury in fact and these same infirmities prevent Oklahoma from establishing a plausible chain of causation between NRC approval of the RRDP and the alleged injuries.

Oklahoma alleges that the RRDP will allow a significant source of radioactivity (the containment cell) to remain at the Fansteel Site and that the cell will release radioactivity to the air and water of Oklahoma, thereby reducing property values and tax revenues, reducing tourism and damaging its roads. Oklahoma does not, however, offer any plausible explanation of how the containment cell will cause these harms. Oklahoma alleges that the containment cell is a significant source of radioactivity, yet it does not specify how much radioactivity will be contained within it, nor does it specify how much activity will be released from it, or whether these releases will exceed the applicable limits of 10 CFR § 20.1403. Oklahoma alleges that radioactivity will migrate from the cell to the groundwater and thence to the river via "super highways" that are actually sealed bore holes that are less permeable than the surrounding soil, or by millions of gallons of leachate per year that is actually a few drops per square foot that will be absorbed into the soil. If the radioactivity cannot get to the river, Oklahoma also brings the river to the containment cell. Unfortunately, Oklahoma does not specify how this will happen, only that it will happen. Oklahoma also alleges that there will be insufficient funds to properly maintain the cell, which will cause radioactivity to be released. But again, it does not explain why the funds are inadequate or what level of funding would be adequate, or how this will cause the alleged harms.

Finally, Oklahoma posits a natural phenomenon (an earthquake, tornado, flood) of unspecified magnitude, and of unspecified probability that will cause catastrophic failure of the cell that will harm nearby roads (that presumably survive the cataclysm). In each and every instance, Oklahoma fails to describe a plausible chain of events between the requested license amendment and the alleged injury. Without such a connection between the proposed action and the alleged injury, Oklahoma has not demonstrated this key element of standing.

4. Oklahoma's Alleged Injuries Cannot be Redressed in This Proceeding

The remaining element that Oklahoma must satisfy in order to demonstrate that it has standing is that the alleged injuries will be redressed by a favorable decision. *Bennett v. Spear*, 520 U.S. at 167; *Dellums v. NRC*, 863 F.2d at 971; and *Babcock and Wilcox*, 37 NRC at 81. To establish standing, Oklahoma must show that it is likely, and not merely speculative that the alleged injuries to its interests would be redressed by a favorable decision. *Lujan v. Defenders of Wildlife*, 504 U.S. 555, 500-561 (1992); *Westinghouse Electric Corporation*, (Nuclear Fuel Export License for Czech Republic-Temelin Nuclear Power Plants), CLI-94-7, 39 NRC 322, 332 (1994). Furthermore, the Presiding Officer "shall determine that the requestor meets the judicial standards for standing and shall consider, among other factors--[T]he possible effect of any order that may be entered in the proceeding upon the requestor's interest." 10 CFR § 2.1205(h)(3).

Oklahoma asks that the license amendment be denied because the RRDP does not comply with the requirements of 10 CFR § 20.1403 for restricted release. Request at 24. Oklahoma asserts if such an order is entered in this proceeding, its alleged injuries will be avoided. Request at 14. However, Oklahoma fails to explain how or why the RRDP does not comply with 10 CFR § 20.1403, and how the alleged injuries would be avoided if the license amendment is denied.

Because the Request provides no basis for concluding that the RRDP does not comply with NRC's regulations, Oklahoma may actually be arguing that the regulations themselves are too lax. That is, approval of a decommissioning plan that complies with these regulations will cause the alleged injuries but rejecting such a plan will avoid the harm. Subpart E of 10 CFR Part 20 is the result of an extensive rulemaking process conducted by the NRC to establish appropriate decommissioning requirements. *See* Radiological Criteria for License Termination, Final Rule, 64 Fed. Reg. 39,058, 39,076 (July 21, 1997). Unless specifically authorized by the Commission, parties to informal hearings under Subpart L are not authorized to challenge NRC regulations. 10 CFR § 2.1239(a). Therefore, to the extent that Oklahoma seeks to litigate the acceptability of releases within the limits in 10 CFR § 20.1403 or outside the time frames of 10 CFR § 20.1401, or to argue that means of decommissioning authorized by the regulations may not be used, such litigation is specifically prohibited, and redress for such matters would not be available.

Because its alleged harms cannot be redressed by a decision in Oklahoma's favor, the Request should be denied.

IV. OKLAHOMA'S REQUEST FOR HEARING SHOULD BE DENIED BECAUSE NONE OF ITS AREAS OF CONCERN ARE GERMANE TO FANSTEEL'S REQUEST TO AMEND ITS SOURCE LICENSE

A. Germaneness Requirement

Title 10, Section 2.1205(e)(3), of the Code of Federal Regulations requires that any person (other than the applicant) who requests a hearing concerning the grant, renewal, or amendment of a NRC license "must describe in detail -- [t]he requestor's areas of concern about the licensing activity that is the subject matter of the proceeding." 10 CFR § 2.1205(e)(3) (1999). In ruling on such a request, the Presiding Officer "shall determine that the specified areas of concern are germane to the subject matter of the proceeding . . . ." *Id.* § 2.1205(h) (emphasis

added). In making such a determination, the presiding officer may only look to information supplied in the requestor's hearing petition. *See Chemetron Corp.*, 40 NRC 17, 1994 NRC LEXIS 24, at *5 (July 7, 1994).

Although the stated areas of concern need not be extensive, they "must be sufficient to establish that the issues the requestor wants to raise regarding the licensing action fall generally within the range of matters that properly are subject to challenge in such a proceeding." *Informal Hearing Procedures for Materials Licensing Adjudications*, 54 Fed. Reg. 8269, 8272 (Feb. 28, 1989); *see Id.* at *5-*6 ("[T]here exists the necessity for linking the concerns registered in its hearing petition to the matter under consideration."). In the context of a challenge to the amendment of a NRC license, the Licensing Panel has held that the petitioner must demonstrate a connection between the stated areas of concern and the license amendment under consideration. *See Id.*; *Molycorp, Inc.*, Nos. 40-8794-MLA, 40-8778-MLA, 1999 WL 693964, at *2 (NRC Aug. 25, 1999). Failure to establish such a connection between the stated area of concern and the amendment at issue precludes the presiding officer from concluding that the stated areas of concern are "germane to the subject matter of the proceeding." *See Chemetron*, 1994 NRC LEXIS 24, at *5-*6.

B. The State of Oklahoma's Failure to Establish Germaneness of Its Stated Areas of Concern

As explained more fully below, the State of Oklahoma has failed to establish that any of its six stated areas of concern are germane to Fansteel's request for amendment of its NRC-issued source license.

1. Whether the NRC Intended 10 CFR § 20.1403 to be Applicable to the Fansteel Facility.

Oklahoma's first area of concern is that the presence of uranium and thorium at the Fansteel site makes it ineligible for restricted release under 10 CFR § 20.1403 (1999). Oklahoma

alleges that when the NRC promulgated section 20.1403, it only intended restricted release for facilities containing relatively short-lived radionuclides that will decay to unrestricted dose levels within a finite period (between 10 to 60 years). Request at 27-28. Under Oklahoma's interpretation of § 20.1403, the Fansteel Site is not eligible for restricted release because the radioactive contaminants present there (uranium and thorium) will remain hazardous for billions of years. Request at 27. According to the State, this decay period is too long to constitute a "meaningfully finite period of time" that would qualify for restricted release. *Id.*

This stated concern does not identify an issue germane to this proceeding. Oklahoma's contention that the NRC intended § 20.1403's restricted release provisions to be applicable only to facilities with short-lived radionuclides is entirely inconsistent with the explicit language of the regulation. Nothing in the language of § 20.1403 indicates that the NRC intended for the regulation to apply only to facilities contaminated with short-lived radionuclides. The regulation contains no prohibition on restricted release based on the period of time the radionuclides will decay. Given the lack of ambiguity in § 20.1403 regarding this issue, there is nothing to have a hearing about.

Nonetheless, Oklahoma attempts to support its position that § 20.1403 applies to facilities contaminated with short-lived radionuclides by citing to language contained in the Commission's "Statement of Considerations" that accompanied the adoption of § 20.1403. Request at 27-28, 28 n.15 (citing 62 Fed. Reg. 39058 (July 21, 1997)). The State is reading this language in isolation. The "Statement of Considerations" does not state that the application of § 20.1403 is to be restricted to sites with short-lived radionuclides; rather, the "Statement" simply provides an example of a site containing a short-lived radionuclides to illustrate the rule's application. The "Statement" also provides examples of the rule's application in situations involving long-lived radionuclides. In fact, the Commission specifically stated that it expected some sites involving "large quantities of uranium and thorium combination" to be released under restricted conditions. Moreover, in the NRC's Generic Environmental Impact Statement in

Support of Rulemaking on Radiological Criteria for License Termination of NRC-Licensed Nuclear Facilities, NUREG-1496 ("GEIS"), NRC specifically evaluated the restricted release decommissioning of a reference rare metals extraction plant (such as the Fansteel facility), including a scenario where contaminated soils and slag are stabilized and disposed onsite. GEIS at Appendix C, pp. 2-6 to 2-7, 7-11 to 7-13, 7-36 to 7-40. Thus, it is clear that the Commission intended restricted release to apply to facilities with long-lived radionuclides such as uranium and thorium; as such, the State's concern is inconsistent with the regulation and therefore not germane to the proceeding.

Oklahoma additionally argues that Fansteel cannot avail itself of § 20.1403--a regulation that was passed eight years after Fansteel started decommissioning procedures. Request at 28. This contention also fails to raise any issue germane to this proceeding. The fact that § 20.1403 was passed eight years after Fansteel started its decommissioning process is of no consequence. At the time the NRC adopted § 20.1403, Fansteel had already submitted a decommissioning plan calling for construction of an onsite disposal cell for uranium and thorium contaminated materials. *See* Feasibility Study, Fansteel, Inc. - Muskogee, Oklahoma (1994); Eastern Property Area Decommissioning Plan, Fansteel, Inc. - Muskogee, Oklahoma (June, 1994). The Commission clearly intended § 20.1403 to apply to the Fansteel site despite the fact that the regulation was passed after Fansteel began decommissioning. Consequently, it is clear that § 20.1403 applies to the Fansteel site and that the State's concerns are not germane to this proceeding.

2. Whether the RRDP Demonstrates Compliance With 10 CFR § 20.1403(a) So As To Qualify For Restricted Use Release.

NRC's regulation providing for license termination under restricted conditions states that a site will be considered acceptable for license termination under restricted conditions if the licensee can demonstrate that any further reductions in residual radioactivity that would be necessary to qualify for unrestricted use cannot be made because either: (a) such reductions

would result in net public or environmental harm; or (b) the levels associated with restricted use are As Low As Reasonably Achievable (ALARA). *See* 10 CFR § 20.1403(a) (1999). Oklahoma contends that Fansteel's Decommissioning Plan "wholly fails to demonstrate either of these conditions" as required by section 20.1403(a) and therefore does not qualify for restricted release. Request at 29.

Fansteel conducted an ALARA analysis which demonstrates that onsite containment of radiologically contaminated soils from the remainder of the Fansteel Site, as opposed to offsite disposal of such soils, is indeed ALARA as prescribed by 10 CFR 20.1403(a). *See* Section 2.1.2.7 of Decommissioning Plan, Fansteel, Inc. - Muskogee, Oklahoma (August, 1999). This analysis is based on NRC guidance presented in Draft Regulatory Guide DG-4006 - Demonstrating Compliance with the Radiological Criteria for License Termination ("DG-4006") (August, 1998).

Oklahoma alleges that Fansteel's ALARA analysis contains serious flaws that call its legitimacy into question. As explained below, these allegations are baseless.

First, Oklahoma alleges that Fansteel used an incorrect figure for population density that is less than actual and less than the NRC acceptable input parameter. Request at 29. The population density used in the ALARA analysis is accurate. According to county information for Muskogee County, the 1996 county population was 83.6 persons per square mile (3.23×10^{-5} person/square meter). [Muskogee County, Oklahoma Website: http://www.odoc.state.ok.us/index.html]. However, even if the analysis used the "default" population density of 0.0004 person/m^2 in the ALARA equation, the result does not change.

Second, Oklahoma states that the analysis uses an excessively low value for the area of the disposal cell (13,823.5 m^2 vs. 6-12 acres). Request at 30. The value used in the model reflects one configuration of the cell that was being considered, and the area of the cell will change somewhat, based on design refinements and review comments from NRC and others. This

parameter, like population density described above, does not significantly affect the analysis. Using an area of 6 acres (footprint of cell) or 24,280 m^2 in the ALARA equation (and a population density of 0.0004) does not significantly impact the result. Thus, the changes that would result using Oklahoma's numbers are not material.

Third, Oklahoma argues that using monetary discount rates of 3% and 7% is not appropriate. These values are specified in DG-4006. *See* U.S. NRC Draft Regulatory Guide DG-4006; Demonstrating Compliance With the Radiological Criteria for License Termination (August, 1998). "For doses averted beyond 100 years, a 3% discount rate should be used." *Id.* at 124. The draft guide states that a monetary discount rate of 3% should be used for soil. *Id.* at Table 3.1. A 3% discount rate also is the more conservative discount rate (compared to 7%). The RRDP uses a 3% discount rate as specified by NRC. RRDP at 2-13.

Fourth, Oklahoma alleges that Fansteel's ALARA analysis uses a "blatantly unrealistic" figure for the thorium concentration. Request at 30. Oklahoma misinterprets this value. The value used is not concentration, rather it is the dose contribution from the cell, which was derived using the RESRAD output which was provided in Appendix D of the RRDP. Because the subject of the RRDP is only the containment cell and does not otherwise address cleanup levels for soil contamination, it would be meaningless to use radionuclide concentrations in the ALARA analysis. Instead, the analysis uses doses from the closed containment cell (the restricted release scenario), and the costs for offsite disposal of the soils that would go into the cell (the unrestricted release scenario) to calculate whether the dose averted by decommissioning for unrestricted release was justified by the costs for unrestricted release. This is exactly the showing required by § 20.1403(a) and DG-4006.

Fifth, Oklahoma alleges that Fansteel incorrectly calculates the cost side of the ALARA analysis by ignoring Draft Regulatory Guide DG-4006 direction that identifies costs of long-term maintenance, increased cost for NRC review of a license application for restricted

release (over that for unrestricted release) and decreased property values (due to restricted release) as benefits. Request at 30. Oklahoma misinterprets the regulatory guidance. DG-4006 identifies these factors as costs that would be incurred if a site is released for restricted use and indicates that these costs should be considered in an ALARA analysis for restricted release. NRC identifies the averted cost as benefits for unrestricted release. DG-4006 at § 3.1.6. Fansteel simply moved these factors to the other side of the equation as costs for restricted release. In either case, the result is the same.

Sixth, Oklahoma alleges that Fansteel overstated the costs to decommission the Fansteel Site for unrestricted release. That cost is estimated to be $33,772,000, which is an updated cost from the 1994 Feasibility Study. *See* Decommissioning Plan, Fansteel, Inc. - Muskogee, Oklahoma (August, 1999) Table 1. Moreover, this cost is commensurate with the estimated cost for decommissioning a reference rare metals extraction plant for unrestricted release developed by NRC in the GEIS. *See* GEIS at Appendix C, pp. 7-36 to 7-40.

As demonstrated above, each of the alleged "flaws" in the ALARA analysis are not flaws at all. Fansteel's analysis is fully consistent with NRC guidance and demonstrates compliance with 10 CFR § 20.1403(a). Moreover, even where Oklahoma specifically identifies alternate values for input parameters, Fansteel's sensitivity analysis indicates that using those values would not affect the outcome of the analysis. *See* pp. 28-29, *supra*. Thus, where the allegation is specific, it is immaterial; otherwise, it is too general and unsupported by factual statements for the Presiding Officer to determine that it is germane to this proceeding. Furthermore, because the analysis demonstrates compliance with the regulation, there is no issue to contest in this proceeding.

3. Whether The RRDP Has Demonstrated Compliance With 10 CFR § 20.1403(e) By Assuring That TEDE Levels Would Not Exceed Applicable Limits In the Event That Institutional Controls Fail.

The State of Oklahoma's third area of concern is that Fansteel's RRDP fails to provide reasonable assurances that residual radioactivity at the Fansteel Facility has been reduced so that if institutional controls were no longer in effect at the Fansteel Facility, the total effective dose equivalent (TEDE) from residual radioactivity distinguishable from background to the average member of the critical group would not exceed 100 mrem/year (or alternatively 500 mrem/year), as required by 10 CFR § 20.1403(e). Request at 33. Oklahoma's criticism of the RRDP is based on its perceived "[e]rrors in the modeling performed by Fansteel, including the assumptions and input parameters used in such modeling [that] render the modeling in the Restricted Release Decommissioning Plan unsubstantiated." *See id.* Oklahoma, however, fails to point to any particular model, assumption, or input parameter as being erroneous, nor does it otherwise explain why Fansteel's modeling is unacceptable. This lack of specificity prevents the presiding officer from determining whether these general statements are germane to the subject matter of the proceeding.

Oklahoma also alleges that the RRDP fails to provide reasonable assurances that residual radioactivity at the Fansteel Site have been reduced so that if institutional controls were no longer in effect, the TEDE from residual radioactivity distinguishable from background to the average member of the critical group would be in compliance with 10 CFR § 20.1403(e). Request at 34. This is wrong. The RRDP contains dose modeling for a resident farmer scenario assuming no cover over the containment cell--a scenario reflecting a complete loss of both institutional controls and physical barriers--and calculates a maximum dose of 94.2 mrem/yr.--below the limit of 100 mrem/yr. specified in § 20.1403(e). *See* Page 3-10 of Decommissioning Plan, Fansteel, Inc. - Muskogee, Oklahoma (August, 1999). Because Fansteel has demonstrated that doses from the containment cell are below 100 mrem/yr. without institutional controls, Fansteel has demonstrated compliance with § 20.1403(e). Oklahoma has not identified any errors

in the modeling performed by Fansteel which would change this conclusion. Again this lack of specificity prevents the presiding officer from determining whether these general statements are germane to the subject matter of the proceeding.

4. Whether The RRDP Has Demonstrated Compliance With 10 CFR § 20.1403(b) By Providing Institutional Controls That Reasonably Assure Doses Will Not Exceed 25 mrem/yr. TEDE.

Oklahoma's fourth area of concern criticizes Fansteel's compliance with § 20.1403(b), which required facilities seeking restricted release to make provisions for legally enforceable institutional controls that provide reasonable assurance that the TEDE from residual radioactivity distinguishable from background to the average member of the critical group will not exceed 25 mrem/year. *See* 10 CFR § 20.1403(b) (1999). Oklahoma alleges that the RRDP fails "to adequately demonstrate legally enforceable institutional controls" because the proposed controls "cannot reasonably be expected to be effective in the near term, much less for 1,000 years or for the enormous lengths of time associated with the half-lives of the long-lived radioactive contaminants at the Fansteel Facility," nor can they be considered "durable enough to provide an appropriate level of protection of public health and safety for the extreme amount of residual radioactivity Fansteel proposes to permanently placed at the Fansteel Facility." Request at 34-35. These concerns do not raise any issue germane to this proceeding.

First, § 20.1403(b) does not require the licensee to provide proof that its institutional controls will be effective for the 1,000 year period specified in 10 CFR § 20.1403(d); "[r]ather, institutional controls should be established with the objective of lasting 1,000 years. . . . having done this, the licensee would be expected to demonstrate that the institutional controls could be reasonably expected to be effective into the foreseeable future." 62 Fed. Reg. at 39070 (emphasis added). The Commission's Statement of Considerations indicates its recognition that no institutional control can be proven to be effective for 1,000 years and thus, the Commission does not require licensee to provide such impossible proof. In short, Oklahoma's concern does

not present an issue that can be litigated in this proceeding because there is no requirement that Fansteel demonstrate that its institutional controls will be effective for 1,000 years.

Also, Oklahoma's contention that the proposed institutional controls "cannot reasonably be expected to be effective" is too vague to be germane to the subject matter of this proceeding. The State does not explain how or why the proposed controls are deficient, nor does Oklahoma identify any preferable alternative. Oklahoma's conclusory statements that the proposed controls are ineffective does not provide enough specificity to demonstrate that the State's concern is germane to this proceeding and that there are issues present that merit a hearing.

Oklahoma also raises concerns over Fansteel's alleged failure: (1) "to definitively identify the long-term custodian of the Fansteel Facility;" (2) "to adequately map out long-term custodial care of the Fansteel Facility;" (3) to address adequately the "[m]aintenance and replacement of the disposal cell, rip-rap, fence, etc.;" and (4) to acknowledge that "[d]eed restrictions at the Fansteel Facility . . . are of and [sic] doubtful value for long-term institutional control, especially for the extreme lengths of time at issue." Request at 35. Once again, Oklahoma simply concludes that the long-term care plans are inadequate without providing any specific explanation as to how or why these plans are deficient--vague statements that a proposed plan is inadequate is not enough to establish that an area of concern is germane to the proceeding. *See Sequoyah Fuels Corp.*, 40 NRC 314, 316 (1994) ("[A] statement of concern must provide enough specificity to afford the Presiding Officer the ability to link the concern with the subject matter of the proceeding. . . .").

5. Whether The RRDP Contains Sufficient Financial Assurance To Enable An Independent Third Party to Assume and Carry Out Responsibilities for the Control and Maintenance of the Site as Required By 10 CFR § 20.1403(c).

Oklahoma's fifth area of concern is that "the financial assurance proposed by Fansteel in the RRDP is insufficient to enable an independent third party to assume and carry out responsibilities for control and maintenance of [the] Fansteel Facility as required by 10 CFR § 20.1403(c)." Request at 36. Specifically, Oklahoma challenges Fansteel's calculation of the annual costs of long-term site control and lists a number of items that it believes were not accounted for. *Id.* at 36-37. As explained below, no item in the State's list raises an issue germane to this proceeding.

a. Repair and Replacement of Disposal Cell and Disposal Cell Cap

Oklahoma identifies repair and replacement of the cell and the cap as from separate items, when in fact they are a single item. The containment cell proposed by Fansteel is a single system comprised of an engineered base, stabilized waste form and durable cover. Fansteel has provided financial assurance for cell cover repair, which is the only exposed part of the cell. There is no rational reason to replace the cell, and if maintenance is performed as required, there is no rational reason to replace the cover. Thus, to the extent that there are necessary and reasonably anticipated costs, Fansteel has provided for them, and there is no germane issue to litigate.

If Oklahoma's concern is that the amount provided for cell repair is not realistic, it does not explain why. Without any specific details, Oklahoma does not demonstrate the required link to the subject matter of this proceeding. *See Sequoyah Fuels Corp.*, 40 NRC at 316.

b. Short- and Long-Term Testing, Analysis, and Monitoring Cell Performance; Repair and Replacement of Groundwater Monitoring Systems

Short-term testing, analysis, and monitoring of cell performance, which includes groundwater monitoring, do not need to be included in the financial assurance calculation because such costs are already accounted for through the NRC's pre-termination requirements that: (1) the licensee provide funding for two years of disposal cell performance monitoring; and (2) any detected inadequacies be fixed. Furthermore, Fansteel will remain at the site after the cell is closed to continue operations of the groundwater treatment system. During that time, while the license is still in effect, Fansteel will perform these tasks. Thus, funds do not have to be provided for a third party. The costs of long-term monitoring and testing, again including groundwater monitoring, are required only for sites where the TEDE level would exceed 100 mrem/year if institutional controls were to fail. *See* 10 CFR § 20.1403(e)(2). Fansteel has demonstrated that the TEDE levels would not exceed the 100 mrem/year limit; thus, long-term monitoring costs are not required under the regulations. Thus, this is not a necessary funding element and is not germane to the proceeding.

c. Future Remediation, Decontamination, and Decommissioning and Additional Cleanup in the Event that Radiological Criteria are Not Met and residual Radioactivity at Fansteel Facility Poses a Significant Threat to Public Health and Safety

Again, Oklahoma identifies the same activities as separate cost elements. Costs for future remediation, decontamination, decommissioning and additional cleanup are not required to be included in the financial assurance calculation because, under 10 CFR § 20.1401(c), these costs can only be imposed if, "based on new information, [the Commission] determines that the criteria of [Subpart E] were not met and residual activity remaining at the site could result in significant threat to public health and safety." *Id.* The Commission has explained that the "chances of previously unidentified contamination being discovered would be expected to be small" and the potential for significant public risk "smaller still." 62 Fed. Reg. at 39,081. Because the

Commission has regulated when these costs are to be imposed, additional cleanup and future remediation costs need not also be accounted for in the financial assurance calculation. Consequently, the failure to include such costs is not an issue that can be litigated in this proceeding. Furthermore, the RRDP addresses only the cell -- there is no other contamination to deal with, thus there is no other contamination outside the cell that would be covered in this action.

d. Collection and Remediation of Leachate From Disposal Cell

As described in the RRDP and above, the containment cell is designed to prevent the generation of radioactive leachate and there is no leachate collection system to operate. *See* Decommissioning Plan, Fansteel, Inc. - Muskogee, Oklahoma (August, 1999); Remedial Design Report - Stabilization and Solidification of Above-Action Level Soil and Construction of Containment Cell, Fansteel, Inc. - Muskogee, Oklahoma (August, 1999). Accordingly, the costs for leachate collection and remediation are not reasonably expected and are not germane to this action. However, as part of the DP for unrestricted release, Fansteel has installed and is presently operating a groundwater collection and treatment system that intercepts groundwater from the proposed cell location and other areas. Fansteel will operate that system until groundwater quality meets applicable standards, which is not anticipated to occur until after the cell is closed. That system will also intercept any contaminated liquids that might come from the cell, in the extremely unlikely chance that such liquids would ever be generated. That system is not part of the RRDP and is not germane to this proceeding.

e. Engineered Barrier Replacement

The State claims that the cost of engineered barrier replacement was not included. This issue is not germane to the proceeding because the State provides no explanation as to what an "engineered barrier" is – the issue is too vague for consideration. *See Sequoyah Fuels Corp.*, 40 NRC at 316.

f. Emergency Planning and Training

Emergency planning and training are not required by the applicable regulations. *See* 10 CFR § 40.31(j)(1) (1999). Moreover, Oklahoma has not demonstrated that there is any reasonably anticipated need for such planning and training that would require Fansteel to include these costs in its financial assurance calculations. Given that emergency planning and training costs are not required under the applicable regulations, there is no regulatory basis for a hearing regarding this area of concern. *See Babcock & Wilcox Co.*, 39 NRC at 217-18.

g. Site Security

Fansteel has included reasonably anticipated costs for site security in its decommissioning financial assurance. Costs for installing a fence around the restricted area are provided, as are costs for maintaining the fence. *See* Decommissioning Plan, Fansteel, Inc. - Muskogee, Oklahoma (August, 1999). The Site will be patrolled by the local police department, which is not an additional cost to be assured by the licensee. Beyond these measures, the concern is too vague to be addressed in this proceeding. *See Sequoyah Fuels Corp.*, 40 NRC at 316.

h. Funding for Enforcement of Institutional Controls

This alleged area of concern apparently relates to the regulatory requirements of 10 CFR § 1403(e)(2)(iii). *See* Request at 37, n. 24. This regulation only applies to facilities where the potential dose assuming a failure of institutional controls would exceed 100 mrem/year. Fansteel has demonstrated that this is not the case for the proposed cell. Therefore, this regulation and this requirement do not apply and this is not a germane issue in this proceeding.

i. Costs of Preventing the Migration and Flow of the Arkansas River into the Disposal Cell at the Fansteel Facility and Other Unforeseen Problems, Acts of God, or Force Majeure Events

As described earlier, the migration of the Arkansas River into the containment cell is not a credible event and the costs for preventing an incredible event are not reasonably anticipated costs for which financial assurances must be provided. Therefore, this is not a germane issue for this proceeding.

As for Other Unforeseen Problems, Acts of God, and Force Majeure Events, these are, by their very nature, not reasonably anticipated events for which financial assurance must be provided. They are also too vague to be addressed in this proceeding. *See Sequoyah Fuels Corp.*, 40 NRC at 316.

6. Whether The Containment Cell Design Proposed by Fansteel Is Sufficient.

Oklahoma's final area of concern is a collection of vague and general allegations about the adequacy of the design and location of the proposed containment cell. Many of the alleged deficiencies are simply the same naked statements concerning injury in fact that allege harm from radioactive releases of unspecified timing, duration or magnitude and are too vague and unsupported by factual statements for the Presiding Officer to determine whether they are germane to this proceeding. Other alleged deficiencies ignore Fansteel's design analyses and postulate incredible release scenarios that might cause doses to exceed regulatory limits, but which cannot reasonably be anticipated to occur within the 1,000 year timeframe specified in 10 CFR § 20.1401. As such, the hypothetical doses are beyond the regulatory timeframe and are not germane to this proceeding. Furthermore, they are an impermissible challenge to NRC regulation, per 10 CFR § 2.1239, and are therefore not germane.

Each of the individual alleged deficiencies suffers one or both of these infirmities which are fatal to a determination of germaneness. This is demonstrated in the following paragraphs.

First, Oklahoma restates its concerns about the cell's potential impact on the waters of Arkansas. Oklahoma incorrectly claims that the cell will be built on native soils and implies that the absence of a liner and leachate collection system is a design deficiency (Request at 38), yet it provides no factual statements to support a claim that the design will cause doses to exceed regulatory limits within regulatory specified timeframes. These concerns cannot support a determination of germaneness. *See Sequoyah Fuels Corp.*, 40 NRC at 316.

Similarly, Oklahoma misinterprets and misapplies Fansteel's stability analysis and waste form leachability studies to postulate a potential release from the cell to groundwater (Request at 38), yet it does not specify any factual support for how much radioactivity might be released, when it might be released, or how this would otherwise cause dose limits to be exceeded. Thus, the allegations are too vague for the Presiding Officer to be able to determine whether these issues are germane.

Oklahoma alleges that Fansteel's long-term maintenance budget is not adequate and will "amplify and accelerate" the contamination process. Oklahoma does not specify how an inadequate maintenance budget will amplify the contamination process or accelerate it. This allegation is too vague to be litigated. Furthermore, this allegation seems to be a short version of Oklahoma's fifth area of concern (regarding financial assurance), and to the extent that it is, they suffer the same infirmities fatal to a determination of germaneness.

To illustrate the certainty that Fansteel's containment cell will fail and that Fansteel's maintenance budget is inadequate, Oklahoma cites the case of the failed landfill caps at the Lone Mountain facility and provides color photos of these caps. Request at 39, n.25 and Request Exhibit 10. Oklahoma fails to explain the relevance of the Lone Mountain facility to this

proceeding. It is completely unlike Fansteel's proposed containment cell in all respects. Lone Mountain is a hazardous waste landfill, not a stabilized monolith; the finished slope at Lone Mountain is over twice as steep as Fansteel's cell; the Lone Mountain cap is constructed of entirely different materials and by entirely different methods. Yet, incredibly, Oklahoma asserts that the Lone Mountain design is more substantial than Fansteel's. Because the Lone Mountain facility is wholly unlike the Fansteel Facility and is wholly irrelevant to this proceeding, the references to it and photos of it should not be considered by the Presiding Officer and should be stricken from the record.

Oklahoma reiterates its concern that placing the cell over properly sealed bore holes and wells will provide a "super highway" for contaminants to enter the aquifer. Request at 39, 40. Oklahoma does not allege that Fansteel will not properly seal these wells as required by Oklahoma regulations, nor does it specify how these wells will cause doses from the containment cell to exceed regulatory limits. The adequacy of Oklahoma's well sealing regulations is not germane to this proceeding and the allegation is otherwise too vague to establish a germane concern.

Oklahoma cites its municipal waste law in support of its allegation that the design and location of Fansteel's proposed cell is inadequate. Again, Oklahoma fails to explain why this law is relevant to the cement-stabilized monolith that is the subject of this proceeding. Neither the adequacy or relevance of Oklahoma's municipal landfill law is germane to this proceeding.

Oklahoma reiterates its concern that the Arkansas River will migrate out of its bedrock channel and inundate the Fansteel Site, causing a catastrophic failure of the cell. Oklahoma fails to identify how this event could reasonably be expected to occur, given the 25 flow control dams installed on the Arkansas River, and how it would cause doses to exceed the regulatory limits within the 1,000 years specified in § 20.1401(d). Thus, there is no issue to be litigated regarding the migration of the river.

As described earlier, Oklahoma's references to the migration of the Red River and the Mississippi River (Request at 41 and Request Exhibit 6) are irrelevant to this case and should not be considered by the Presiding Officer. Furthermore, it is particularly unclear how the catastrophic failure of Fansteel's containment cell caused by migration of the river would cause the alleged harms, including hindering navigability of the relocated river. Request at 41.

Oklahoma also restates its concerns about the inadequacy of the proposed long-term maintenance budget and its alleged impacts on Oklahoma's air quality. Request at 41-42. This is essentially the same concern as stated earlier regarding the budget's impact on water quality and it suffers the same vagueness and the same lack of germaneness.

Oklahoma further alleges that the proposed containment cell will be located in the probable maximum floodplain and Fansteel failed to account for failure of upstream dams in the cell design. Request at 42. This allegation is wrong. The proposed cell location is outside the 500 year flood plain (*see* Remedial Design Report - Stabilization and Solidification of Above-Action Level Soil and Construction of Containment Cell, Fansteel, Inc. - Muskogee, Oklahoma (August, 1999) Appendix B.2), and flooding due to upstream dam failures was specifically evaluated.

Flooding due to dam breach or maximum spillway discharge at Oologah Lake was considered in the Final Design Report. The proposed cell is outside of the flood that would be caused by either event. It follows that since Grand Lake, Keystone, Hudson, and Pensacola are smaller, the floods from these dams will not affect the Fansteel cell. *See id.* at Appendix B.2.1. Failure of the Choteau Dam will inundate the area up to an elevation of approximately 526 feet. The base elevation of the containment cell is 528 feet. Therefore, this flood event will not impinge on the side slope of the protective cover. *See id.* at Appendix B.2.1.a. The flood level due to the catastrophic failure of the Fort Gibson dam will extend up to elevation 543 feet. The top plan elevation for the monolith cover is elevation 548 feet. Therefore, a portion of the cover

will be topped by this catastrophic flood event. As demonstrated by the analysis presented in the Final Design Report, the predicted low gradient of this flood when it reaches the monolith will not cause excessive tractive force. The monolith will withstand the failure of the Fort Gibson Dam. *See id.* at Appendix B.2.1.

Lastly, Oklahoma alleges that the RRDP fails to consider the existing 24" sewer main and existing gas main near the proposed cell location. This too is wrong. The locations of the sewer and gas lines were considered in siting and design of the disposal cell. *See id.* at Volume 1, Drawing # 3789306 (Figure 5). The gas line will be at least 10 feet to the south and up slope of the cell. The gas line is relatively shallow and any trench dug for repair of the line would certainly not extend into the material. *See id.* The sewer line will be at least 30 feet east of the cell and it is approximately ten feet deep. Therefore, a trench excavated for repair would be a maximum of about 30 feet wide, and will only project toward the cell about 15 feet. The repair trench would not disturb the cell. *See id.*

As demonstrated above, none of Oklahoma's alleged concerns about the adequacy of the proposed containment cell design and location are germane to the proceeding because there are either too vague, or they are unsupported by factual statements demonstrating issues that can be litigated, or they are otherwise irrelevant to the proposed action.

V. CONCLUSION

As Fansteel has demonstrated in this Answer in Opposition to Oklahoma's Request for Hearing, Oklahoma has not satisfied the requirements to be granted a hearing. Oklahoma has not demonstrated that it has standing, as it has not established that the proposed approval of the Restricted Release Decommissioning Plan would cause injury in fact to its purported interests or that a favorable decision would redress any alleged injury. Additionally, Oklahoma has not identified areas of concern germane to the challenged action. Accordingly, Oklahoma's request for hearing should be denied.

Respectfully submitted,

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Counsel for Fansteel, Inc.

Dated: October 29, 1999

CERTIFICATE OF SERVICE

I hereby certify that copies of the foregoing "Fansteel, Inc.'s Answer in Opposition to the Request for Hearing Filed by the State of Oklahoma" have been served upon the persons listed below by certified U.S. mail, return receipt requested, this 29th day of October, 1999.

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Daniel P. Trocchio

Exhibit 1

USGS science for a changing world

Central Region Energy Resources Team

Effects of produced waters at oilfield production sites on the Osage Indian Reservation, northeastern Oklahoma

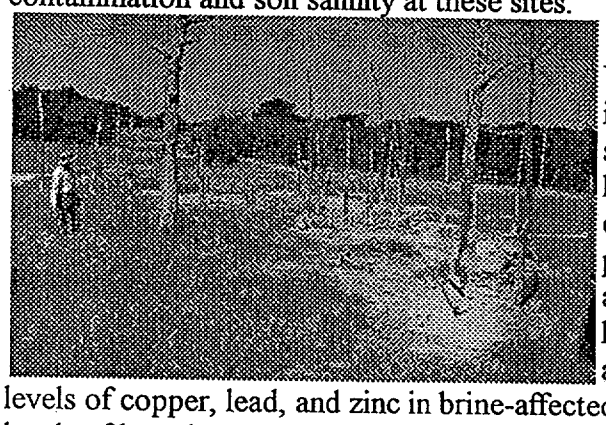
U.S. Geological Survey

Open-File Report 97-28

By James K. Otton, Sigrid Asher-Bolinder, Douglass E. Owen and Laurel Hall

ABSTRACT

The authors conducted limited site surveys in the Wildhorse and Burbank oilfields on the Osage Indian Reservation, northeastern Oklahoma. The purpose was to document salt scarring, erosion, and soil and water salinization, to survey for radioactivity in oilfield equipment, and to determine if trace elements and naturally occurring radioactive materials (NORM) were present in soils affected by oilfield solid waste and produced waters. These surveys were also designed to see if field gamma spectrometry and field soil conductivity measurements were useful in screening for NORM contamination and soil salinity at these sites.



Visits to oilfield production sites in the Wildhorse field in June of 1995 and 1996 confirmed the presence of substantial salt scarring, soil salinization, and slight to locally severe erosion. Levels of radioactivity on some oil field equipment, soils, and road surfaces exceed proposed state standards. Radium activities in soils affected by tank sludge and produced waters also locally exceed proposed state standards. Laboratory analyses of samples from two sites show moderate levels of copper, lead, and zinc in brine-affected soils and pipe scale. Several sites showed detectable levels of bromine and iodine, suggesting that these trace elements may be present in sufficient quantity to inhibit plant growth. Surface waters in streams at two sampled sites exceed total dissolved solid limits for drinking waters. At one site in the Wildhorse field, an EM survey showed that saline soils in

the upper 6m extend from a surface salt scar downvalley about 150 m.

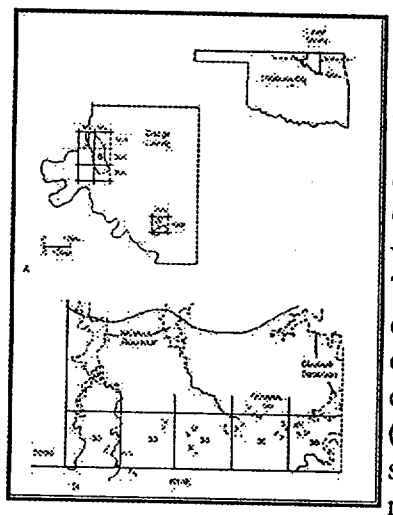
(Photo [95k]: Dead oak trees and partly revegetated salt scar at Site OS95-2 in the Wildhorse field, Osage County, Oklahoma.)

In the Burbank field, limited salt scarring and slight erosion occurs in soils at some sites and low to moderate levels of radioactivity were observed in oil field equipment at some sites.

The levels of radioactivity and radium observed in some soils and equipment at these sites are above levels of concern as defined in regulations proposed by the Conference of Radiation Control Program Directors. The volumes of material involved appear to be relatively small for most sites. The lead levels observed in soils affected by tank sludge wastes are about one half of the US Environmental Protection Agency (USEPA) interim remedial action levels used for Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and Resource Conservation and Recovery Act (RCRA) sites (400 ppm).

Field gamma spectrometry proved useful in delineating areas where radium has been added to the natural soil by oilfield solid waste and produced water, although the technique does not meet standards of assessment used in the state of Louisiana which require core sampling of 15 cm intervals and radiochemical analysis in the laboratory. Further work is needed to develop field gamma spectrometry as a substitute for the more expensive coring and laboratory analysis. The ratio of radium-228 to radium-226 may hold promise in evaluating the relative ages of NORM contamination at a site.

INTRODUCTION



Investigations on the Osage Indian Reservation (Fig. 1A) are part of a study of the effects of produced waters on soils, shallow bedrock, surface waters, and shallow ground waters being conducted by the U.S. Geological Survey. Produced waters in oil and gas fields are often extremely briny (as much as 35 weight percent total dissolved solids, Collins, 1975). Original formation waters throughout Osage County were very briny with most waters ranging from 75,000 to 250,000 ppm TDS (Wright and others, 1957). In addition to high concentrations of dissolved sodium and chloride, and lesser concentrations of other major elements, these produced waters and solids formed from them can contain varying amounts of naturally occurring radioactive materials (NORM, principally radium-226 and radium-228) and trace elements such as arsenic, barium, selenium, cadmium, chromium, copper, lead, nickel, silver, zinc, mercury, lithium, and boron (Collins, 1975). The effects of the surface disposal of produced waters can include the death of vegetation, soil erosion and siltation of streams, lakes, and reservoirs, and contamination of soil, ground water and surface water by salts, hydrocarbons, trace elements, and NORM.

The USEPA estimates that 30 percent of oil and gas production operations in the U.S. may have levels of NORM in brine and brine solids sufficiently elevated to be of concern (USEPA, 1993). One industry estimate suggests that if strict regulatory requirements for assessment and cleanup of NORM were put in place in the U.S., 20 percent of oil production and 8 percent of gas production would become uneconomic (Smith and others, 1995).

As in many producing areas of the U.S., in the early 1900s Osage County produced waters were often dumped on the surface or in nearby washes and streams. This practice later gave way to the use of brine evaporation ponds. Still later, companies injected produced waters for waterflooding and for maintaining field pressures. As regulations governing brine discharges were put into place, injection disposal wells became extensively used. Many injection, waterflooding, and pressure maintenance wells encountered problems with equipment failures, leakage across geologic structures, and leakage up improperly plugged and abandoned older production wells. This history suggests that salt scarring and past contamination of soils and ground and surface waters are likely to be common in the county. Previous deep geophysical surveys had mapped the presence of brine plumes in the subsurface in the Burbank field area (Fitterman, 1985; Raab and Frischknecht, 1985).

A 1989 American Petroleum Institute (API) survey of radioactivity in active U.S. oil production and gas processing equipment included oil production equipment at 115 sites in Osage County (Otto, 1989). The average radioactivity across the county was 87 microRem per hour (mR/hr) above background and the median and 75th percentile values were 4 and 32 mR/hr above background, respectively. The maximum observed value was 3391 mR/hr above background. Slightly more than 25 percent of the oilfield equipment measured in Osage county exceeded the USEPA radioactivity standard used in uranium mine tailings reclamation sites (25 mR/hr above background). High values observed in the API survey occur mostly on separator tanks, water storage tanks, and water lines where brine scale and tank sludge accumulate.

An aeroradiometric survey of Osage County was conducted as part of the National Uranium Resource Evaluation (NURE) survey of the Department of Energy (Texas Instruments, 1978). East-west flightlines spaced at a nominal 6 miles (10 km) were flown across the county. These data show that equivalent uranium values for the eastern part of the county (an area underlain mostly by sandstone and shales) generally range from 1.0-2.0 ppm (0.33-0.67 pCi/g radium-226). In the western part of the county (an area underlain mostly by limestone) equivalent uranium values are generally somewhat higher (1.5-2.5 ppm, 0.5-0.8 pCi/g radium-226). Some anomalies in the profiles are related to the presence of uranium-enriched black shales; however, some substantial equivalent uranium anomalies occur (as much as 10 times background) that have no geologic explanation. The NURE report interpreted these anomalies as caused by "possible Ra-rich oilfield brines". The largest of these anomalies (about 5 pCi/g Ra-226 maximum) occurs over the Wildhorse oilfield.

In the soil survey of Osage County, Bourlier and others (1979) identified "oil-waste land" as one of the soil map units and indicated that 1927 acres (0.1 percent) of the county is underlain by this unit. Our studies of aerial photos and our field inspection of the Wildhorse oilfield suggest that 1) a large number of small areas of active salt scars are not mapped in the soil survey; and 2) extensive areas of probable older salt scars, now revegetated with grasses, were not included in this soil map unit. This suggests that considerably more Osage County acreage is underlain by active and historic salt scars.

This report describes salt scarring and erosion at selected sites in the Wildhorse oilfield, provides information regarding the presence of trace elements in soils in the Wildhorse oilfield, provides survey information for NORM at operations in the Wildhorse and Burbank oilfields, and documents shallow soil salinization at one site in the Wildhorse field.

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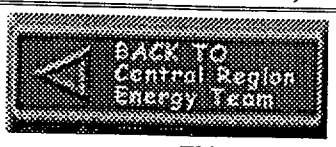

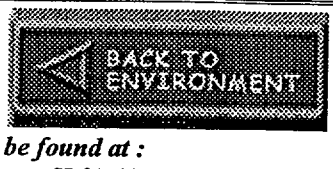

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Maintained by C. Adkisson---last updated October 16, 1997

ash, and boiler slags are used as substitutes in cement and concrete, as structural fills, for snow and ice control, and as blasting grits. The potential impact of long-term accumulation of by-products in the biosphere should be considered (Gabbard 1993).

Coal ash is used as an additive in concrete, cement, and roofing materials, land reclamation, paint and undercoatings, and various products and as a structural fill for road construction. About 30%of ash is reused. There is concern that fly ash may become regulated in the future, which would discourage reuse.

Oil and Gas Production Scale and Sludge

The rate of production of domestic crude oil is closely tied to the international price of crude and to fluctuations that depend on world-wide political and economic conditions. Production for the month of November 1995 was estimated at 6.5 million barrels per day (API 1996). Production in 1970 was approximately 9.6 million barrels per day. It is estimated that about 25 thousand MT (27.5 thousand short tons) of TENORM scale and 230 thousand MT (253.5 thousand short tons)of TENORM sludge are generated from domestic production each year, based on 1989 figures.

Radioactivity in oil and gas production and processing equipment is of natural origin and is now known to be widespread, occurring throughout the world. Estimates suggest that up to 30 % of domestic oil and gas wells may produce some elevated TENORM contamination. The geographic areas with the highest recorded measurements were northern Texas and the gulf coast crescent from southern Louisiana and Mississippi to the Florida panhandle. Very low levels of TENORM radioactivity were noted in California, Utah, Wyoming, Colorado, and northern Kansas fields.

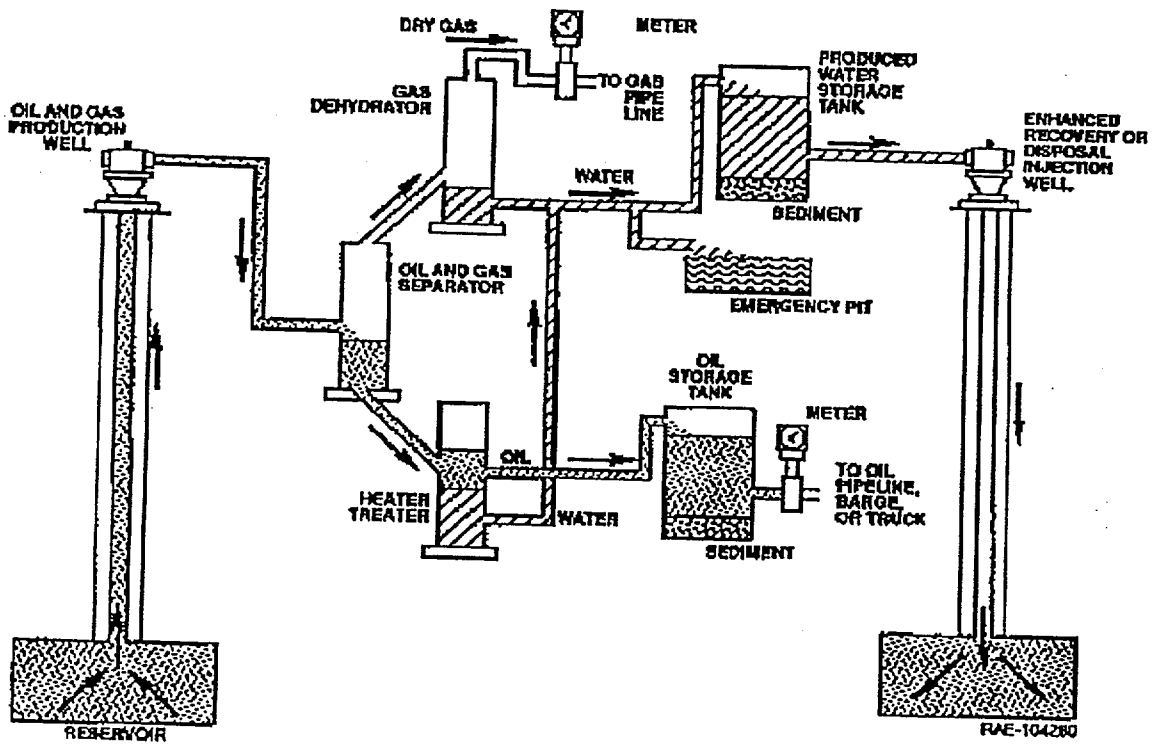
Uranium and thorium compounds are mostly insoluble and as oil and gas are brought to the surface, remain in the underground reservoir. As the natural pressure within the bearing formation falls, formation water present in the reservoir will also be extracted with the oil and gas. Some radium and radium daughter compounds are slightly soluble in water and may become mobilized when this production water is brought to the surface. The precipitate consists principally of barium sulfate ($BaSO_4$), calcium sulfate ($CaSO_4$), and calcium carbonate ($CaCO_3$). Because the chemistry of radium is similar to that of barium and calcium (all are Group IIA elements), radium may also precipitate to form complex sulfates and carbonates.

The amount of TENORM material from a producing field generally increases as the amount of water pumped from the formation increases. Since radium concentrations in the original formation are highly variable, the concentrations that precipitate out in sludges and as scale on internal surfaces of oil and gas production and processing equipment are also variable. This scale in these chemical matrices is relatively insoluble and may vary in thickness from a few millimeters to more than an inch. Scale deposits in production equipment may at times become so thick to completely block the flow in pipes as large as 10.1 cm (4 in.) in diameter.

Radium-226 is generally present in scale in higher concentrations than ^{228}Ra. Typically, ^{226}Ra in scale is in equilibrium with its progeny, but ^{228}Ra is not. The nominal activity appears to be about three times greater for ^{226}Ra than for ^{228}Ra (Table 12).

The oil and gas production stream passes through a separator where the oil, gas, and water are divided into separate streams based on their different fluid densities (Fig. 7). Most of the solids removed in the separator accumulate there. The product may also be treated using a heater/treater to separate oil from produced water and sludge. The produced water flows from the separators into storage tanks and is often injected into disposal or recovery wells. Scales are usually found in piping and tubing, including oil flow lines, water lines, injection and production well tubing, manifold piping and small-diameter valves, meters, screens, and filters. Concentrations on TENORM occurred in wellhead piping and production piping near the wellhead. Concentrations of radium in scale deposited in production tubing near wellheads can range up to tens of thousands of pCi/g. The concentration of radium deposited in separators is about a factor of ten less than that found in wellhead systems. There is a further reduction of up to an order of magnitude in the radium concentration in heater/treaters. The concentration in granular deposits found in separators range from one to about one thousand pCi/g. The largest volumes of scale have been found in the water lines associated with separators, heater/treaters, and gas dehydrators.

Fig.7. Oil and gas equipment



TENORM radionuclides may also accumulate in gas plant equipment from ^{222}Rn decay products, even though the gas is removed from its ^{226}Ra parent. Rn-222 concentrates in the liquid petroleum gas (LPG) fraction during processing. Gas plant deposits differ from oil production scales, typically consisting of radon decay products plated out on the interior surfaces of pipes, valves, and other gas plant equipment. The only significant radionuclides

remaining in gas plant equipment are ^{210}Po and ^{210}Pb.

Table 12. Average Radionuclide Concentrations in Oil and Gas Scale

Radionuclide	Concentration, Bq/g (pCi/g)
Ra-226	13.3 (360)
Pb-210	13.3 (360)
Po-210	13.3 (360)
Ra-228	4.44 (120)
Th-228	4.44 (120)

Source: description_hereEPA 1993.

Radon flux rates from scale are hard to determine. Several factors, such as particle size, thickness of the deposit, and the presence of oil and other material may reduce radon flux rates. Since much of the waste is internal to components, it may be challenging to characterize net radon flux. A radon emanation coefficient of 0.05 has been assumed for the referenced report (EPA 1993).

Exposure rates vary widely depending on geographic location and the type of equipment. Median exposure rates were measured for water handling equipment in the ~0.261 to 0.348 uSv/h (30 to 40 uR/h) range. Gas processing equipment with the highest levels include reflux pumps, propane pumps, and tanks and lines. Median exposure rates were reported to be in the ~0.348 to 0.609 uSv/h (30 to 70 uR/h) range. For both oil and gas processing equipment, a few measurements were observed to be in excess of ~8.7 uSv/h (1 mR/h).

The origin of TENORM-contaminated sludge is similar to that of scale. As the produced water is subjected to changes in temperature and pressure, dissolved solids may precipitate out of solution and deposit sludge within the oil production system. These deposits are generally in the form of oily, loose material. Sludge often contains silica compounds, but may also contain significant amounts of barium. Some of the solids in the original product stream are removed in the separator and accumulate there as sludge. As the stream is further treated using heater/treaters to separate oil from water, sludge is also separated and allowed to accumulate. The largest volumes of sludge settle out of the production stream and remain in the oil stock and water storage tanks. Radionuclide concentrations in sludge vary from background levels to several hundred pCi/g, with the highest concentrations in the separator and collection areas near the separator (drains, etc.) (Table 13). The levels deposited in heater/treaters and in sludge holding tanks are about a factor of 10 less than those found in the separator. TENORM concentrations in sludge deposits in heater/treaters and tanks are generally around 2.78 Bq/g

(75 pCi/g).

Table 13. Average Radionuclide Concentrations in Sludge

Radionuclide	Concentration, Bq/g (pCi/g)
Ra-226	2.07 (56)
Pb-210	2.07 (56)
Po-210	2.07 (56)
Ra-228	0.7 (19)
Th-228	0.7 (19)

Source: EPA 1993.

Radon flux from sludge is also hard to characterize for several reasons. The presence of oil or other petroleum products associated with the sludge may reduce radon flux rates. The presence and concentration of ^{226}Ra will govern radon flux and diffusion properties from sludge. A radon emanation coefficient of 0.22 was assumed for the referenced report (EPA 1993).

Oil field tubulars and equipment are now surveyed for the presence of radioactivity, and contaminated equipment is either held in storage or sent to a commercial decontamination facility. Tank sludges are also surveyed for radioactivity, dewatered, and held in storage pending disposal.

In some states, production water from oil and gas industry is disposed down hole. In addition, well injection for slurried material at limited concentrations has been permitted for oil field TENORM. Some oil field scale is stored in drums. The industry disposes of scale and sludge wastes removed from production equipment and also discards contaminated components. There are instances where TENORM waste is disposed of off-shore, under license from the United States Mineral Management Service.

Waste Water Treatment Sludge

Since water for domestic use comes from streams, lakes, reservoirs, and aquifers, it contains varying amounts of naturally occurring radioactivity. Radionuclides are leached into ground or surface water when water comes in contact with uranium- and thorium- bearing geologic media. The predominant radionuclides found in water include radium, uranium, and radon, as well as their progeny.