Omaha Public Power District

1623 HARNEY ■ OMAHA, NEBRASKA 68102 ■ TELEPHONE 536-4000 AREA CODE 402

February 26, 1982
LIC-82-051

Mr. Robert A. Clark, Chief
U. S. Nuclear Regulatory Commission
Office of Nuclear Reactor Regulation
Division of Licensing
Operating Reactors Branch No. 3
Washington, D.C. 20555

Reference: Docket No. 50-285

Dear Mr. Clark:

The Commission's letter dated November 10, 1981 requested Omaha Public Power District provide additional information regarding the proposed storage of uranium hexaflouride (UF_6) at the Fort Calhoun Station. The District's response is attached.

Please note the attached response references storage areas #1 and #2. The District plans to store the UF_6 in one of these two areas and is presently evaluating the soil load bearing capacity of each. The District will determine which of the two areas is more appropriate and will inform the Commission by April 1, 1982.

The District believes the Commission should note that the Model 48X storage cylinders have been used for many years. These canisters have been storing the UF_6 material for the past eight to ten years without incident and the storage conditions at the Fort Calhoun Station are similar to the conditions at the Kerr McGee facility in Gore, Oklahoma. Union Carbide, the manufacturer of the cylinders, has strenuously tested prototypes of the cylinders for strength and durability. The final design incorporated all improvements which were considered necessary with respect to enhanced structural integrity and shipping considerations. The onsite storage of UF_6 in the solid form will not pose any hazard to the environment or to plant operations, since UF_6 is considered very stable. The ERDA (DOE) approved canisters are designed to safeguard against significant hazards by employing limits on U^{235} enrichment, mass, volume, geometry, and spacing. Procedures incorporating these safety considerations have been developed and evaluated at the ERDA (DOE) facilities during the past 25 years.

Sincerely,

W. C. Jones
Division Manager
Production Operations

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1/1

WCJ/KJM/TLP/RWS:jmm

Attachment

cc: LeBoeuf, Lamb, Leiby & MacRae

A. Storage Area

A.1 Provide a facility plot plan showing the proposed storage location and its relationship to ventilation intakes and prevailing winds at the Fort Calhoun Station.

Response

The facility map showing the proposed storage locations is provided in Figure A-1. Storage area #1 is in the northwest corner of the onsite substation. The approximate locations of the control room and the technical support center ventilation intakes are shown in Figure A-1 with the approximate distances, from the storage area, of 1700 feet and 1600 feet, respectively.

The wind directional persistency data for July 1, 1977 through June 30, 1981 is presented in Table A-1. The prevailing winds are from the northwest and north-northwest sectors with wind frequencies of 12.33% and 10.64%, respectively. Storage area #1 will be in the west-southwest wind sector with a wind frequency of 3.31%.

Storage area #2 is approximately 200 feet north of the station storeroom and 150 feet east of the railroad spur. Approximate distances between this area and the control room and technical support center ventilation intakes are 600 feet and 500 feet respectively. This location is in the west wind sector with a wind frequency of 4.24%.

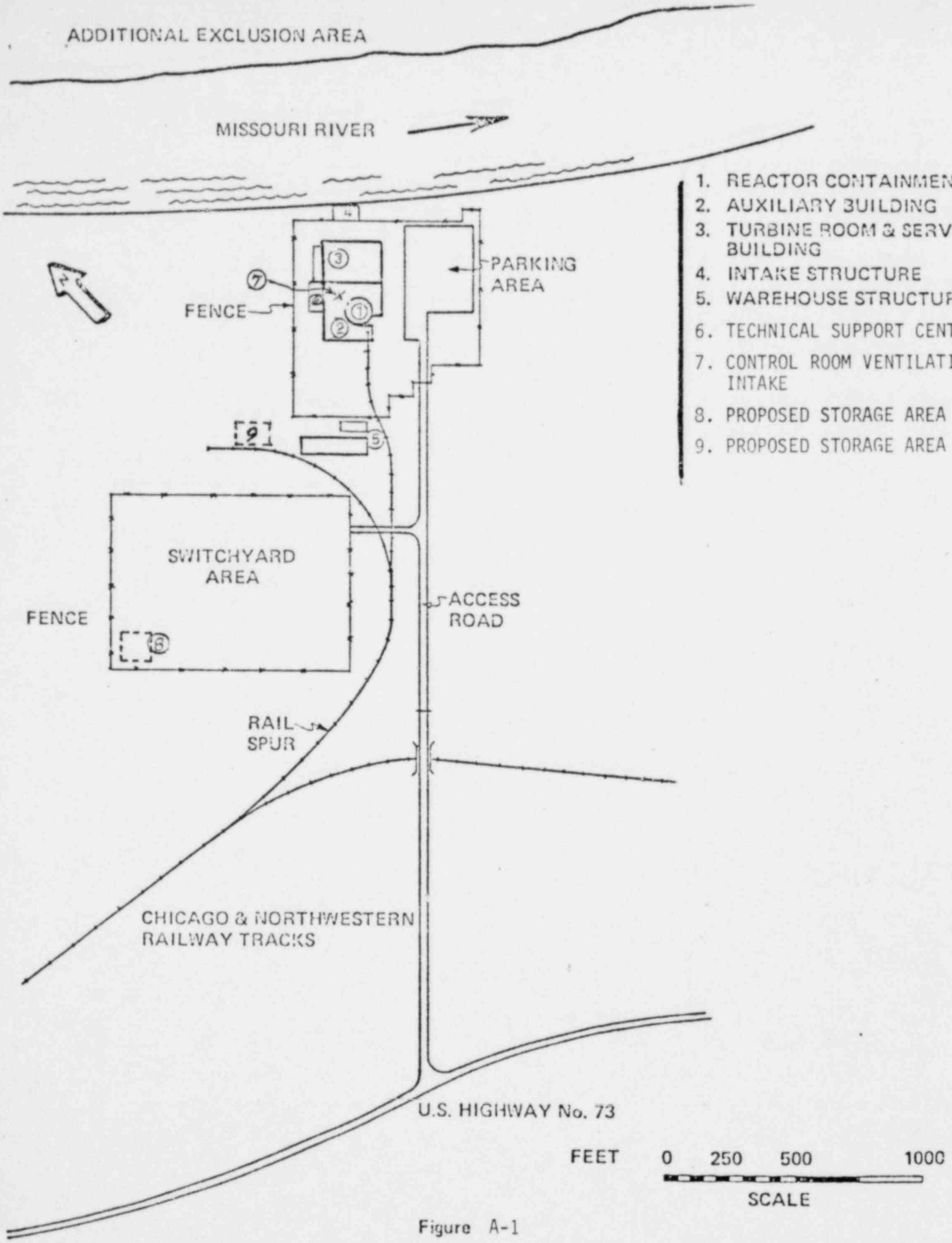

Figure A-1

OMAHA PUBLIC POWER DISTRICT

FT. CALHOUN STATION UNIT No. 1

SITE PLAN

TABLE A-1

FORT CALHOUN STATION UNIT NO. 1
JOINT FREQUENCY DISTRIBUTION
DATA PERIOD JULY 1, 1977 THROUGH JUNE 30, 1981

Sector*	Wind Frequency Per Year (Percent)
NNE	3.35
NE	2.58
ENE	2.23
E	3.14
ESE	5.60
SE	9.29
SSE	9.18
S	9.70
SSW	7.02
SW	4.08
WSW	3.31
W	4.24
WNW	7.93
NW	12.33
NNW	10.64
N	5.26

* Sector is Wind Direction

A.2 Describe the cylinder storage conditions (e.g. existing ground with or without cylinder cradles, concrete or asphalt pad with or without cylinder cradles, hold-down straps, inside or outside storage, security fences, stacking cyclinders, cylinder valve protection, fire protection).

Response

Storage area #1 is in the northwest corner of the Substation enclosure and will be enclosed by a separate fence that will be appropriately marked. The Substation is a 700' x 950' rectangular area enclosed by chainlink fence seven feet tall and topped with three strands of barbed wire for a security fence eight feet tall. There are three gates in the fence, each twelve feet wide, that are kept locked except for entry by authorized OPPD personnel.

The surface of the Substation is graded from an elevation of 1003 feet msl at the eastern and western fence lines to an elevation of 1006 feet msl at the center, thus providing for drainage away from the transmission and distribution components located at the center of the enclosure. The elevation of storage area #1 is an average of 1003 feet msl with a slight incline from east to west, a 1 foot drop in a traverse of 60 feet, to provide for drainage. The surface of storage area #1 is covered with crushed limestone and no additional paving, e.g. concrete or asphalt, is planned.

Storage area #2 is approximately 200 feet north of the onsite storeroom and 150 feet east of the railroad spur indicated on Figure A-1. Storage conditions for this area would include fence and surface condition comparable to area #1. Entry would be limited to authorized OPPD personnel.

The UF_6 cylinders will be stored with the long axis of the cylinder parallel to, and elevated from, the crushed limestone covered ground on railroad tie

cradles. The cradles will be made by attaching wedges to the railroad ties at locations to provide maximum cylinder stability without the use of tie-down devices. Tie-down devices are not considered necessary during storage because of the large weight of each individual cylinder (25,530 pounds nominal gross weight) and the low probability of movement by natural forces (see response to Item D); also the cylinders will not be stacked. Stacking would require tie-down devices to prevent the bottom row from rolling out from under the top row.

Cylinder valve protection, as designed for the Model 48X Cylinder is now in place at Kerr-McGee, and will remain so throughout shipping and the storage period.

The proposed storage locations will be maintained free of combustible materials. In addition, the cylinders are made of steel, and the UF_6 and hydrolized products are not combustible; therefore, no fire protection systems are planned. However, CO_2 fire extinguishers, available in the Interim Emergency Operations Facility and/or the storeroom for spot cooling of a cylinder if a leak should develop, will ensure that fire protection is adequate.

B. Inspection Program

B.1 Describe your inspection program for receipt and prior to transfer. Include your criteria for rejecting the cylinder(s) and planned actions you will take to make the cylinder(s) acceptable for receipt or transfer.

Response

All cylinders will be inspected by a Kerr-McGee qualified inspector prior to transfer from Gore, Oklahoma per DOE inspection procedure, A-1.1, detailed in ORO-671, Volume 1. Inspection results will be recorded on a "UF_6 Cylinder Inspection Data Sheet," (Figure B-1) and copies will accompany the shipment to Fort Calhoun Station. All DOT and NRC regulations applicable to the transportation of UF_6 will be observed during shipping to the Fort Calhoun Station.

Prior to storage, an OPPD qualified inspector will check the Kerr-McGee inspection sheets and conduct an inspection of the cylinders per DOE inspection procedure, A-1.1. Inspection results will be recorded on a "UF_6 Cylinder Inspection Data Sheet" (Figure B-1).

Damage to cylinders discovered during either pre-shipping or pre-storage inspections is classified as acceptable or unacceptable based on the criteria defined in ORO-671, Volume 1. A cylinder shall be deemed unacceptable for receipt if any "Unacceptable" block is checked on the "UF_6 Cylinder Inspection Data Sheet" (Figure B-1) for that cylinder during the OPPD pre-storage inspection.

A comparison between Kerr-McGee pre-shipping inspection sheets and OPPD pre-storage inspection sheets will be made, and any discrepancies will be resolved through discussion with Kerr-McGee and the carrier. Damage will be repaired as necessary, prior to acceptance for storage of any cylinder deemed unacceptable. Minor damage, e.g., bent, broken, or mispositioned valves,

UF_6 CYLINDER INSPECTION DATA SHEET

CYLINDER NUMBER	CYLINDER MODEL ☐ 30A (2½-ton) ☐ 48A (10-ton) ☐ 48G (14-ton LW) ☐ 30B (2½-ton) ☐ 48F (14-ton HW) ☐ _____	☐ Date Shipped _____ ☐ Date Received _____ Hydrostatic Pressure Test Date of _____ is ☐ Acceptable ☐ Not Acceptable Carrier _____	CYLINDER BEING INSPECTED ☐ Prior to Being Shipped ☐ After Being Received ☐ Prior to Being Filled ☐ Prior to Being Heated
OWNER	CYLINDER STATUS ☐ Full ☐ Empty, Heel of _____ Pounds is ☐ Acceptable ☐ Not Acceptable		

Cylinder is Code Stamped ☐ Yes ☐ No

Cylinder's Contents Are Solidified ☐ Yes ☐ No

Cylinder is Overfilled: ☐ No ☐ Yes, Net Weight is _____ pounds; Maximum Allowable Fill Limit is _____ pounds.

		CONDITION		
		Acceptable	Unacceptable	Not Applicable
I. CYLINDER VALVE, VALVE PORT AND PLUGS	A. VALVE:			
	1. Physical Damage			
	2. Thread Engagement			
	3. Valve Cap - Present and in Place			
	B. VALVE PORT:			
	1. Plugged with UF_6			
	2. Contaminated with Other U-Salts or Foreign Material			
	C. PLUGS:			
	1. Physical Damage			
	2. Thread Engagement			
	D. VALVE PROTECTOR - PRESENT AND PROPERLY POSITIONED			
	E. SEAL			
	Description of Damage (if any):			
II. CYLINDER WELDS	A. CIRCUMFERENTIAL HEAD SEAM WELD - VALVE END			
	B. CIRCUMFERENTIAL HEAD SEAM WELD - PLUG END			
	C. LONGITUDINAL SEAM WELD			
	Description of Damage (if any):			
III. CYLINDER SHELL AND HEADS	A. SHELL			
	B. HEAD - VALVE END			
	C. HEAD - PLUG END			
	Description of Damage (if any):			
IV. STIFFENING RINGS	A. VALVE END			
	B. CENTER			
	C. PLUG END			
	Description of Damage (if any):			
V. SKIRTS	A. VALVE END			
	B. PLUG END			
	Description of Damage (if any):			

DATE AND TIME INSPECTED _____ INSPECTED BY _____

SECTION A

THIS SECTION TO BE COMPLETED BY A QUALIFIED INSPECTOR (FOR DAMAGE REFERRED TO THE INSPECTION DEPT.)

Remarks _____

The above item(s) is ☐ Acceptable ☐ Unacceptable

DATE _____ QUALIFIED INSPECTOR _____

SECTION B

THIS SECTION TO BE COMPLETED WHEN THE DAMAGE INDICATED ABOVE IS INSPECTED AND APPROVED BY OTHER THAN INSPECTION DEPT. PERSONNEL

The following damage has been inspected and approved (with the indicated limitations, if any): _____

DAMAGE APPROVED BY _____ TITLE _____ DATE _____

DISTRIBUTION White - Uranium Control (KYRC) Blue - Inspection (When Section A is Completed) Buff - Originator

CONDITION LEGEND A - Acceptable U - Unacceptable NA - Not Applicable

Figure B-1

TYPICAL CYLINDER INSPECTION DATA SHEET

plugs or valve protectors, discovered during the OPPD pre-storage inspection will be repaired by OPPD personnel. More extensive damage, e.g dirt or stiffener ring torn from the shell, broken stiffener ring or other damage requiring welding for repair, discovered during the pre-storage inspection will be referred to Kerr-McGee. Before repair work requiring welding can be performed, the damaged cylinder must be emptied due to density differences between solid and liquid UF_6. Liquid UF_6 occupies a 24% larger volume than solid UF_6, therefore, localized heating of a storage cylinder must be avoided. The above mentioned repair work will be referred to Kerr-McGee because OPPD does not have the necessary facilities for emptying or filling the cylinders.

B.2 Describe your inspection program for long-term storage. Include your criteria for determining if a cylinder is no longer acceptable for storage and planned actions you will take to make the cylinder acceptable for continued storage.

Response

The inspection program for long-term storage of UF_6 cylinders will consist of the pre-storage inspection, as described in the response to Item B.1 above, a bi-ennial inspection and a pre-shipping inspection of the cylinders utilizing the same DOE procedure A-1.1.

The results of the bi-ennial inspection will be evaluated to determine if a cylinder is acceptable for continued storage service. A cylinder will be removed from storage service if any damage to the cylinder is discovered during the bi-ennial inspection that fits the criteria described in ORO-671, Volume 1.

In the unlikely event a cylinder is deemed unacceptable for continued storage service, the District would repair the defect or ship the cylinder for repair or replacement in accordance with industrial and approved practices for UF_6 storage cylinders.

Further, the following security measures will be taken:

1. The storage area gates will be kept locked except for entry by authorized OPPD personnel.

2. Personnel authorized for entry to storage area #1 will be on business pertaining to maintenance of the transmission and distribution components or receipt/shipping/inspection of UF_6 cylinders. Personnel authorized for entry to storage area #2 will be on business pertaining to receipt/shipping/inspection of the storage cylinders.
3. The Fort Calhoun Station Security Force conducts routine patrols, minimum of once per 8 hour shift, of the site boundaries and areas not under continuous surveillance by closed-circuit television cameras.
4. Any abnormal situation or appearance would be reported by the Security Force and an individual would be dispatched for further investigation.

The occurrence of any physical damage to a cylinder that would meet the criteria of "Unacceptable Damage" of ORO-671, Vol. 1, Figure 2 is extremely unlikely based upon the security precautions and storage location described above, and the low probability of occurence of natural disaster described in the response to Item D.

C. Industrial Accidents

C. Provide a discussion and assessment of the following industrial accidents to include (1) preventive measures, (2) health, safety and environmental impact to cylinder storage area, other station areas (e.g., containment building, turbine building), and beyond the site boundaries if the accident should occur, and (3) your personnel, procedures, equipment and facilities for dealing with these accidents if they should occur.

C.1 Failure of a cylinder either during on-site handling or storage when the cylinder contains only solid UF_6.

Response

The Model 48X ten-ton shipping and storage cylinder is designed and constructed as a high integrity containment vessel for Uranium Hexafluoride (UF_6) with a maximum enrichment of 4.5%. Design, construction and testing have been conducted in accordance with the following standards and regulations: ANSI N-14.1-1971; ASME Boiler & Pressure Vessel Code, Section VIII, Division 1; 10 CFR Part 71. See Table C-1 for structural design criteria per 10 CFR Part 71. Due to the design, construction and testing criteria specified by ANSI, ASME, NRC and ERDA (DOE), catastrophic failure of the Model 48X Cylinder during shipping or storage is considered highly unlikely (See Allied General Nuclear Services Safety Analysis Report for Model 48X UF_6 Packaging).

At any time during on-site handling or storage, the cylinder contents will be solid with a low concentration of UF_6 gas occupying the space above the solid. In the event solid UF_6 is released to the atmosphere, it will react with the moisture in the air (hydrolize) forming UO_2F_2, a white powder which

TABLE C-1

STRUCTURAL DESIGN CRITERIA

APPLICABLE PARAGRAPH FROM 10CFR71	SUBJECT	COMPONENT	CRITERIA	COMMENTS
71.31	Lifting devices	Cylinder lifting lugs	Support at least 3 times the weight of the loaded package without generating stresses in the packaging exceeding yield.	
	Tie-down devices	Cylinder lifting lugs	2g vertical, 5g transverse, 10g longitudinal transport loading.	
		Auxiliary lifting holes in skirt,		
		Stiffening rings, cylinder wall.		
	Lifting & Tie-down devices	All above	Failure of device(s) due to excessive load will not impair the containment integrity of the cylinder.	Excessive load is defined as that load which will result in a structural failure in the packaging.
71.32	Load resistance	Cylinder wall	Support at least 5 times the weight of the loaded package as a simple beam without generating stresses in the packaging exceeding yield.	

TABLE C-1 (Cont'd.)

APPLICABLE PARAGRAPH FROM 10CFR71	SUBJECT	COMPONENT	CRITERIA	COMMENTS
71.32 (Cont'd.)	External pressure	Cylinder wall & heads	Containment vessel integrity maintained when a 25 psig external pressure is applied.	Determined for -40°F condition to maximize pressure differential.
71.35(a)(1) 71.35(a)(2)	Internal pressure 130°F ambient Full insolation	Cylinder wall, heads and stiffening rings	No yielding	212°F steam chest results in greater temperature and pressure.
71.35(a)(2)	-40°F ambient in still air and shade.	Cylinder wall, heads, stiffening rings, and tie-down/lifting devices.	No brittle fracture, no yielding	Low vapor pressure of UF_6 contributes to pressure differential.
	External pressure	Cylinder wall, heads, and stiffening rings.	No yielding in the packaging for a reduction in atmospheric pressure to 0.5 atm.	Less severe than pressure differential resulting from 130°F ambient.
	Vibration	Packaging	Natural frequency exceeds 20 Hz.	No failures in more than 10 years of use in road and rail transport.
	1-foot free drop	Skirts, stiffening rings, cylinder, wall, heads.	No reduction in packaging effectiveness (containment).	Paducah test results cited.
	Penetration	Valve	No reduction in packaging effectiveness (containment).	Paducah test results cited.
	Compression	Cylinder wall	Uniform compressive load of 50,000 pounds applied to top & bottom of Cylinder in normal position of transport.	

tends to settle on surfaces, and HF, a colorless vapor. The solid UF_6 will also sublime to UF_6 gas and then hydrolize to UO_2F_2 and HF. A visible plume of the white UO_2F_2 powder and HF vapor will result and will be easily traceable. The plume will disperse at a rate governed by wind speed and other meteorological conditions. UO_2F_2 and HF concentrations in the plume will be governed by the amount of UF_6 exposed and the amount of water vapor in the atmosphere.

Health, safety, and environment impact beyond the site boundaries will be a toxic chemical, rather than a radiological hazard and is dependent upon the wind speed, wind direction and other meteorological conditions effecting plume dispersal. A release of UF_6 of the magnitude postulated would be placed in an appropriate emergency classification as described in Section D of the Fort Calhoun Station Radiological Emergency Response Plan. Notification of State and Local authorities would be made consistent with the emergency classification declared.

The following discussion illustrates that the radiological hazard from a UF_6 release is insignificant when compared to the chemical hazard of the Uranium released in the form of UO_2F_2.

The expected quantities of radioisotopes in the UF_6 product (and thus the UO_2F_2) were calculated for natural enrichment uranium on the basis of decontamination factors for the UF_6 conversion process. Of the fission product impurities in the uranyl nitrate product from the BNFP Separations Facility, only traces of ruthenium-rhodium (Ru-Rh) will be carried over into the UF_6 (UO_2F_2) product. The Zr-Nb impurities, which form non-volatile fluorides, will remain in the UF_6 facility's fluorinator bed. Thus, the only gamma-emitting fission product in the UF_6 (UO_2F_2) product will be trace quantities of Ru-Rh isotopes, and Ru-106 is the only element of concern from a radiological hazard standpoint.

The isotope U-237 will be present in the UF_6 (UO_2F_2) in the Cylinder. At the time of shipment, the radiation source contribution from this isotope is approximately the same as that from the U-235 isotope. The Ru-Rh isotopes, primarily Ru-106 emit the most penetrating of the radiation sources used in the shielding analysis.

The UF_6 (UO_2F_2) product has been stored until the U-237 isotope has decayed to within shipping specifications. The concentration of gamma-emitting isotopes is expected to be no more than 0.032 Ci/MTU of Ru-Rh and 0.13 Ci/MTU of U-237. In addition, the concentration of the U-235 in the product UF_6 (UO_2F_2) will be no more than 0.0214 Ci/MTU.

For radiological considerations it is assumed that the Ru-Rh isotopes are released in the particulate form and only Ru-106 is assumed to be the source term with a total activity of 0.32 Curies (0.032 Curie/MTU X 10 tons). All of the activity is conservatively assumed to be released to the environment following a cylinder rupture. The two-hour whole body dose to a child at the site boundary will be approximately 1.0E-05 Rem (based on a DCF of 1.09E-06 mrem/pCi, χ/Q of 4.4E-04 sec/m^3 and a breathing rate of 6.9E-05 m^3/sec) which is 4.2E-05 percent of the limits specified in 10 CFR Part 100. There are no significant neutron sources.

Direct contact with the plume should be avoided, as the HF is a mild but very penetrating acid when in contact with skin or other tissue such as the linings of the throat or lungs. Rubber or plastic protective clothing should be worn to prevent skin contact with the HF and respiratory equipment should be worn to prevent inhalation of the UO_2F_2 and HF. The inhalation of fumes from very large releases for more than a few breaths may result in temporary lung impairment quite soon after the exposure and in some instances mild but repairable kidney damage within a few days. UO_2F_2 is a water soluable heavy metal compound that is toxic to the kidneys when inhaled or ingested in large quantities.

Impact on the operation of Fort Calhoun Station would be very small considering the storage location in relation to prevailing winds and the station ventilation system intakes. As stated in the response to Item A.1 above, the wind direction necessary to carry a UO_2F_2/HF plume over the station ventilation system intakes will be west-southwest with a frequency of 3.31% for storage area #1, or west with a frequency of 4.2% for storage area #2. The station ventilation systems can be isolated so that no outside air will be brought in if a release occurs with the wind blowing from the above defined direction. In the event of a significant release, evacuation of the plant, which would potentially expose many people to the plume, would be unnecessary.

Health, safety and environmental impact to either of the storage areas would be small because 1) the storage areas are in a remote sector of the plant site, 2) UO_2F_2 and HF will have no adverse effects on any equipment located near either of the storage areas, and 3) there is no significant vegetation in either of the storage areas or in the direction of the prevailing winds.

Response personnel, procedures, equipment and facilities are described in the response to Item E, below.

Accident prevention will be provided by the location of the storage area and by cautious handling by a crane operator experienced in the handling of large loads. The proposed storage location inside the Substation enclosure, storage area #1, is a minimum of 200 feet from transmission and distribution components and is enclosed by a separate fence. Storage area #2 is 200 feet north of the storeroom, 150 feet east of the RR spur and 100 feet west of the construction road. These are very low vehicle and personnel traffic areas. The only traffic in or near either of the storage areas will be pertaining to shipment or receipt of cylinders. Movement of cylinders will be by a 15 ton or greater capacity, truck mounted crane. The truck will be capable of being raised on four hydraulically operated legs to increase stability when the crane is loaded; therefore the lifting equipment is immobile.

In the unlikely event of lifting cable failure, a free drop from up to a 10-foot height onto the surface of the storage area is not expected to result in cylinder failure based on the following discussion.

Structural integrity of the Model 48X Cylinder was evaluated on the basis of "Free Drop" tests as required by 10 CFR Part 71, Appendix A. Drop tests conducted by AGNS at Paducah, Kentucky exceeded the 10 CFR Part 71, Appendix A requirements for fully loaded cylinders. No cylinder failures are reported for drops of up to thirty feet onto a flat, unyielding surface, although significant deformation was observed. A four-foot drop of a fully loaded (simulated UF_6) cylinder is reported. In this test the cylinder was dropped onto its "top" skirt (valve end). The cylinder remained upright and undamaged

after the drop. A 30-foot drop of a fully loaded (simulated UF_6) cylinder is also reported. The 25,540 pound cylinder was dropped onto the plug end at an angle of 20° from vertical. Maximum deformation to the cylinder body was approximately three (3) inches where the skirt crimped in on the cylinder head. A slight leak occurred at the plug nearest the point of impact. Twenty-foot and forty-inch drop tests from a horizontal attitude onto a flat surface and a six-inch diameter piston, respectively, resulted in cylinder shell deformation but no leakage. A second forty-inch drop onto a six-inch diameter piston was conducted. The point of impact was the center of the cylinder head. Head deformation was three inches, but no leakage was observed. Therefore, significant leakage or cylinder failure from a drop onto a crushed limestone covered surface is considered highly unlikely.

C.2 Failure of a cylinder either during on-site handling or storage when the cylinder contains gaseous UF_6.

Response

As discussed in the response to Item C-1, the cylinders contain solid UF_6 with a volume of gas in the space above the solid. Due to internal pressure of the cylinder, the concentration of the gas will be low. A high concentration of UF_6 gas occupying the volume above the solid is considered highly unlikely due to the chemical characteristics of UF_6 and normal weather conditions at Fort Calhoun Station as discussed in the response to Item C.3, below.

In the event of a small leak, the escaping UF_6 gas would hydrolize, as discussed in the response to Item C.1 above, and the product would plug the leak. Environmental impact from a large leak would be the same as for a release of solid material as discussed in the response to Item C.1, above.

C.3 Failure of a cylinder either during on-site handling or storage when the cylinder contains liquid UF_6. This is unnecessary if it can be shown that such a condition is incredible.

Response

This condition is considered incredible due to the chemical characteristics of UF_6, the weather conditions at Fort Calhoun Station and Nuclear Industry practice relating to shipping and storage of UF_6. Industry practice allows for UF_6 shipping only in solid form with a vapor pressure of less than 14.5 psia. (See ORO-651, Section 6.1). This condition will be maintained during on-site storage. The chemical characteristics of UF_6 provide for a solid material at a temperature and pressure of less than 147.3°F and 22 psia, respectively.

Cylinders in storage subjected to summer solstice insolation on a 130°F day would have a temperature of 178°F (see the AGNS SAR for Model 48X Cylinders). This temperature, 178°F, is for a cylinder oriented with its axis parallel to an east-west vector in still air. These ideal conditions are extemely rare in Nebraska. Maximum daytime summer temperatures are on the order of 100°F and wind is generally blowing at 5 mph or more, therefore, liquification of UF_6 due to daytime peak temperatures during the summer months is considered incredible.

D. Natural Phenomena

D. Provide a discussion and assessment of the following natural phenomena to include (1) health, safety and environmental impacts to cylinder storage area, other station areas (e.g. containment building, turbine building) and beyond the site boundaries and dealing with these if they should occur.

D.1 Earthquakes

Response

From the discussion on Seismicity in the Fort Calhoun Station FSAR Section 2.4, the following sections are reproduced:

2.4.3 Seismic Design Criteria

Although on the basis of the history of the region no significant earthquake ground motion is expected at the site, occasional shocks along the Missouri River and continuation of shocks in the belt extending northward from the Abilene Arch to the Sioux Uplift could be postulated. For conservation in the determination of appropriate seismic criteria the proximity of a fault to the site is considered. On this basis, and in accordance with the recommendations of the U.S. Coast and Geodetic Survey (USC&GS), seismic criteria have been established as follows:

a. Design earthquake: maximum horizontal ground acceleration equal to eight percent of gravity;

b. Maximum hypothetical earthquake: maximum horizontal ground acceleration equal to seventeen percent of gravity.

2.4.4 Conclusion

The site is subject to infrequent slight ground motion from regional shocks. Conservatively, and in line with USC&GS recommendations, the plant is designed for earthquake intensities postulated on the basis of a fault system in the vicinity of the site. The plant is designed for elastic response to ground motion accelerations as high as eight percent of gravity and for a safe shutdown of the reactor for accelerations as high as seventeen percent of gravity.

The model 48X Cylinders were designed per ANSI N14.1 as high integrity vessel primarily used for the shipping of UF_6. Structural design criteria from 10 CFR Part 71, presented in Table C-1, require the cylinder tie-down devices, i.e. wall, stiffening rings, auxiliary lifting holes in the skirts and lifting lugs, to be capable of withstanding the following transport loads: 1) 2g(51,060 pounds) vertical, 2) 5g(127,650 pounds) transverse, and 3) 20g(255,300 pounds) longitudinal. The least of the aforementioned criteria, 2g(51,060 lbs), is a factor of 11.76 greater than the maximum expected earthquake induced loads at the plant site. Therefore, it is considered highly unlikely that cylinder failure will occur from earthquake induced loads.

Health, safety and environmental impact to the cylinder storage area, other station areas and beyond the site bondaries from UF_6 releases is discussed in the response to Item C, above. Personnel, procedures, equipment and facilities for response to UF_6 releases are described in the response to Item E, below:

D.2 Flooding

Response

The proposed storage area #1 is approximately 1800 feet west of the Missouri River at an elevation of 1003 feet msl. Proposed storage area #2 is approximately 900 feet west of the river at approximately the same elevation. The Fort Calhoun Station FSAR, Section 2.7.1.2 states the plant design flood peak

stage is 1004.2 feet msl. The design flood peak stage is slightly greater than the 0.1% probability flood, when the probability curve is extrapolated. Therefore the 1004.2 ft. msl stage is conservative and proper for use. Additionally, the ground rises to an elevation of 1006 feet msl between the river and storage area #1. Storage area #2 will be graded to a suitable elevation prior to placement of cylinders for long-term storage.

The peak flood stage during the 1952 flood is documented as 1008.5 feet msl by the Army Corps of Engineers. A flood of this magnitude has a probability of occurance of less than 0.1% due to five (5) flood control dams constructed upstream of Fort Calhoun since 1952.

Design and construction of the Model 48X Cylinder is such that catastrophic cylinder failure due to flooding is considered incredible. Load resistance of the Model 48X Cylinders is discussed in the response to Item C, above.

D.3 Tornados

Response

The low profile, diameter of four feet and length of ten feet, and large weight, 25,530 pounds, significantly reduces the probability of cylinder movement as a result of a tornado on site.

Cylinder rupture as a result of a tornado induced pressure drop is considered incredible based upon calculations presented in the AGNS SAR for Model 48X Cylinders. AGNS postulated an external pressure of 7.4 psia and calculated the resulting effect on the internal pressure. The decrease of 7.4 psi external pressure has the same effect as an internal pressure increase of approximately the same amount. Considering the internal operating pressure of 100 psia, the hydrostatic test pressure of 415 psia and a tornado induced pressure drop of up to 10 psi, the resulting internal pressure of approximately 110 psia is a factor of 3.77 below the hydrostatic test pressure.

Tornado carried debris impacting a cylinder perpendicular to its surface could result in shell fracture and UF_6 release. The probability of such an impact is very low because of the cylinder diameter, however in the event of such an occurance the health, safety, and environmental impact to the storage area, on and off-site areas and operation of the plant would be the same as for UF_6 releases discussed in the response to Item C.1, above.

Response actions, personnel, procedures, equipment and facilities are discussed in the response to Item E, "Emergency Plans".

E. Emergency Plans

E. Include a specific proposed section in the Fort Calhoun Station Emergency Plan to address potential accidents of the proposed storage of UF_6. It is suggested that this be done as a separate addendum to the Emergency Plan, i.e., a UF_6 Accident Contingency Plan.

Response

The Fort Calhoun Station Radiological Emergency Response Plan provides comprehensive action required by NUREG-0654/FEMA-REP-1, Rev. 1. Basic identification, notification, organization, assessment, protective response and exposure control mechanisms are integral features of the Plan. Potential accident effects to the public resulting from the storage of Uranium Hexafluoride (UF_6) are fully reduced within the scope of the existing Emergency Plan.

Specific instruction addressing potential accidents from the storage of UF_6 can be provided to (1) the 'Accident Consideration' section of the Radiological Emergency Response Plan and (2) a separate Emergency Procedure, Uranium Hexafluoride Incident, to the Fort Calhoun Station Operating Manual as proposed below.

1. Radiological Emergency Response Plan, Section Accident Consideration.

8.0 Uranium hexafluoride accidents

Uranium hexafluoride (UF_6) cylinders are stored on-site and will be eventually shipped off-site for fuel processing. The cylinders are constructed of steel and designed in accordance with applicable ANSI and ASME standards. The UF_6 and

its hydrolized products are neither combustible nor a radiological hazard. The health consequence which may result from handling of the bulk material is tissue irritation by inhalation and direct contact. Exposure to UF_6 and its decomposition products could result only from the opening of a cylinder or a loss of container integrity. If a surveillance observation indicates UF_6 is lost from a cylinder, Emergency Operating Procedure Uranium Hexafluroide Incident provides effective response actions to control and minimize the release of the chemical.

2. Emergency Procedure Uranium Hexafluoride Incident

A. Purpose

To describe the actions to be taken in the event that uranium hexafluoride is released from a storage cylinder.

B. Symptoms

Any one or more of the following indications may be present:

1. White crystals at a failed valve or cylinder crack.
2. Irritant, corrosive fumes in the atmosphere.
3. White particles in the air.

C. Immediate Action

1. Notify the Shift Supervisor of an apparent release of uranium hexafluoride and that a detailed examination is to be made for verification purposes.
2. Don self-contained breathing apparatus, gloves and head covering and re-enter area.
3. Inspect storage area closely. Verify crystals are not cylinder corrosion deposits and fumes are not another irritant vapor, such as chlorine or ammonia.
4. Secure cylinder valve if it is the source of the leak.
5. Report inspection observations to Shift Supervisor immediately.

D. Follow-Up Action

1. Apply actions consistent with "Notification of Unusual Event" emergency classification.
2. Control storage area with barricade and labeling.

F. UF_6 Cylinder Materials

F. Clarify the materials of construction for the Type 48X cylinders you plan to utilize.

Response

The Model 48X Cylinders shell and heads are fabricated from ASME SA-516 carbon steel plate, 5/8" thick. Stated tensile strength is 55.0-65.0 ksi with a yield point of 30 ksi. All other structural components are ASME SA-36 (ASTM A-36) structural steel with a stated tensile strength of 58.0-80.0 ksi, yield point of 36.0 ksi and coefficient of Linear Thermal Expansion 6.7E-06 in/in/°F.

Design, construction and testing of each cylinder is per ANSI N-14.1 - 1971, ASME Boiler and Pressure Vessel Code, Section VIII, Division 1 and 10 CFR Part 71.

The Model 48X Cylinder has a one-inch fill valve. The body, packing nut, packing ring, and packing follower are an Aluminum-Silicon-Bronze alloy and the stem is Monel.