H. E. Estridge

COMBUSTION ENGINEERING

February 10, 1989
LD-89-017

Docket 70-36
License No. SNM-33

Mr. Leland C. Rouse
Fuel Cycle Safety Branch, Chief
Division of Fuel Cycle, Medical, Academic and Commercial
Attn: Document Control Desk
U. S. Nuclear Regulatory Commission
Washington, D.C. 20555

Subject: License Amendment Request for R-2 Modifications

Dear Mr. Rouse:

As you know, Combustion Engineering is in the process of revitalizing our Nuclear Fuel Manufacturing Facility at Hematite, Missouri. As part of this program, we plan to perform modifications to the Uranium Hexafloride to Uranium Oxide process line. Our current plans are to commence installation of the initial phase of this modification during the latter part of February.

The enclosures to this letter include proposed amendments to Part I and II of the license application and address the conclusions and results of our safety analysis. Enclosure I provides a list of the affected pages. Enclosure II provides the license application change pages.

A check in the amount of $150.00 to cover this license amendment request, as required by 10 CFR 170.31, is included in Enclosure III. If I can be of any assistance on this matter, please do not hesitate to call me or Mr. C. M. Molnar of my staff at (203) 285-5205.

Very truly yours,

COMBUSTION ENGINEERING, INC.

A. E. Scherer
Director
Nuclear Licensing

AES:jeb
Enclosure I List of Affected Pages
Enclosure II License Change Pages
Enclosure III Check No. 215044
xc: G. H. Bidinger (NRC)
G. D. France (NRC - Region III)
D. A. McCaughey (NRC)
W. G. McDonald (NRC)

R-8

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ENCLOSURE I

COMBUSTION ENGINEERING, INC.

HEMATITE NUCLEAR FUEL MANUFACTURING FACILITY

LICENSE AMENDMENT REQUEST

LIST OF AFFECTED PAGES

FEBRUARY, 1989

HEMATITE NUCLEAR FUEL MANUFACTURING FACILITY

LICENSE AMENDMENT

Combustion Engineering requests that the license (SNM-33) for its Hematite Nuclear Fuel Manufacturing Facility be amended to reflect changes which will be made to the UF_6 to UO_2 conversion line. In brief, this modification involves the addition of a new section to the upper end of the R-2 reactor. This new section is of a larger diameter and extends R-2 to a height of eleven feet four inches. This modification of R-2 will reduce carryover, minimize recycle and reduce material handling.

The license pages affected by this amendment and their respective revision numbers are listed below. The proposed change pages are provided in Enclosure II.

Deleted Page		Added Page	
Page No.	Rev.	Page No.	Rev.
--	-	I.4.5a	0
II.9-1	1	II.9-1	2
II.9-2	2	II.9-2	3
II.9-2a	0	II.9-2a	1
--	-	II.9.2b	0
II.9-3	0	II.9-3	1
II.9-4	1	II.9-4	2
--	-	II.9-4a	0
II.9-5a	2	II.9-5	3
II.9-5a	2	II.9-5a	3

ENCLOSURE II

COMBUSTION ENGINEERING, INC.

HEMATITE NUCLEAR FUEL FABRICATION FACILITY

LICENSE AMENDMENT REQUEST

LICENSE CHANGE PAGES

k) The R-2 steam line will have two (redundant) fail-safe shut-off valves, each activated by two independent high and low temperture alarms setpoints on the R-2 reactor. The operability of this systems will be ascertained at least once every six months.

9.0 NUCLEAR SAFETY ANALYSIS OF UF_6 - UO_2 CONVERSION

9.1 Reactor Vessels and Furnaces

a. Description

Vessel R-2 and it's furnace are shown in cross-section on Figure 9-2. For comparison, the upper end configuration of vessels R-1 and R-3 are shown in dotted lines. The elevation view of the UF_6-UO_2 conversion reactor line is shown on Figure 9-1.

The lower sections (10" diameter and 12" diameter) are the same for all three vessels. Vessel R-2, however, has an additional 16" diameter section which increases the total height to 11'4".

All three vessels are fitted with electrically heated furnaces. R-1 and R-3 have two independently controlled sections and R-2 has three independently controlled sections. All three reactors have low temperature alarm set points and R-2 has a second (redundant) low temperature alarm setpoint. In addition, the steam supply line to R-2 has two shut-off valves (one redundant) which are activated by the low temperature alarm setpoints from the R-2 controllers.

b. Nuclear Safety

Assumptions:
1) Maximum enrichment 5.0%.
2) Under process design (normal) conditions, SNM is only in the 10" diameter lower section of the vessel.
3) Reflection as provided by furnace insulation; and vessel steel walls as shown in Figure II.9-2.

Reactor vessels are supported 30, 20, and 10 feet above the ground level; infinite water reflection is, therefore not credible.

9.1 Reactor Vessels and Furnaces (continued)

c. Conclusions

1) Normal Conditions

The SNM is in the lower 10" diameter portion of the reactors under normal conditions and the vessels are at temperature.

2) Accident Conditions

A nuclear criticality situation may arise only if both of the following abnormal conditions exist:

- the R-2 reactor is overfilled so that there is SNM in the upper disengaging section, and
- water is present to provide moderation.

Instrumentation is provided for each reactor to indicate inlet gas pressure and differential pressure across the fluidized bed. These alarm on over-pressure alerting the operator who then can take action to prevent overfilling.

A loss of temperature could theoretically allow filling the 10" reactor, the 12" disengaging section, and, for R-2, the 16" disengaging section with condensed steam. The postulated failures which could cause loss of temperature and the engineered conditions which prevent steam condensation are as follows:

9.1 Reactor Vessels and Furnaces (continued)

c. Conclusions (continued)

2) Accident Conditions (continued)

a. Thermocouple Failure Failure of a single thermocouple could shut off the power to one of the independently controlled heater sections. Since the temperature controller would fail up-scale, the high temperature would alarm and activate an interlock, shutting off the steam supply. The alternate heater sections would, in any case, provide sufficient power to the reactor to prevent steam condensation.

b. General Power Failure Failure of the power supply to the plant would cause the steam control valves to fail closed, terminating the supply of steam and cause the nitrogen control valve to fail open, purging all steam from the reactors.

c. Failure of a Single Heating Element Since the furnaces are connected to a three phase power supply, the most likely mode of failure is an open circuit in one of the three circuits leaving two circuits and the alternative furnace heating. This would prevent condensation. Furthermore, if the reactor temperature dropped below 600°F, the steam supply to R-2 would automatically shut off and the low temperature alarms would sound.

9.1 Reactor Vessels and Furnaces (continued)

c. Conclusions (continued)

2) Accident Conditions (continued)

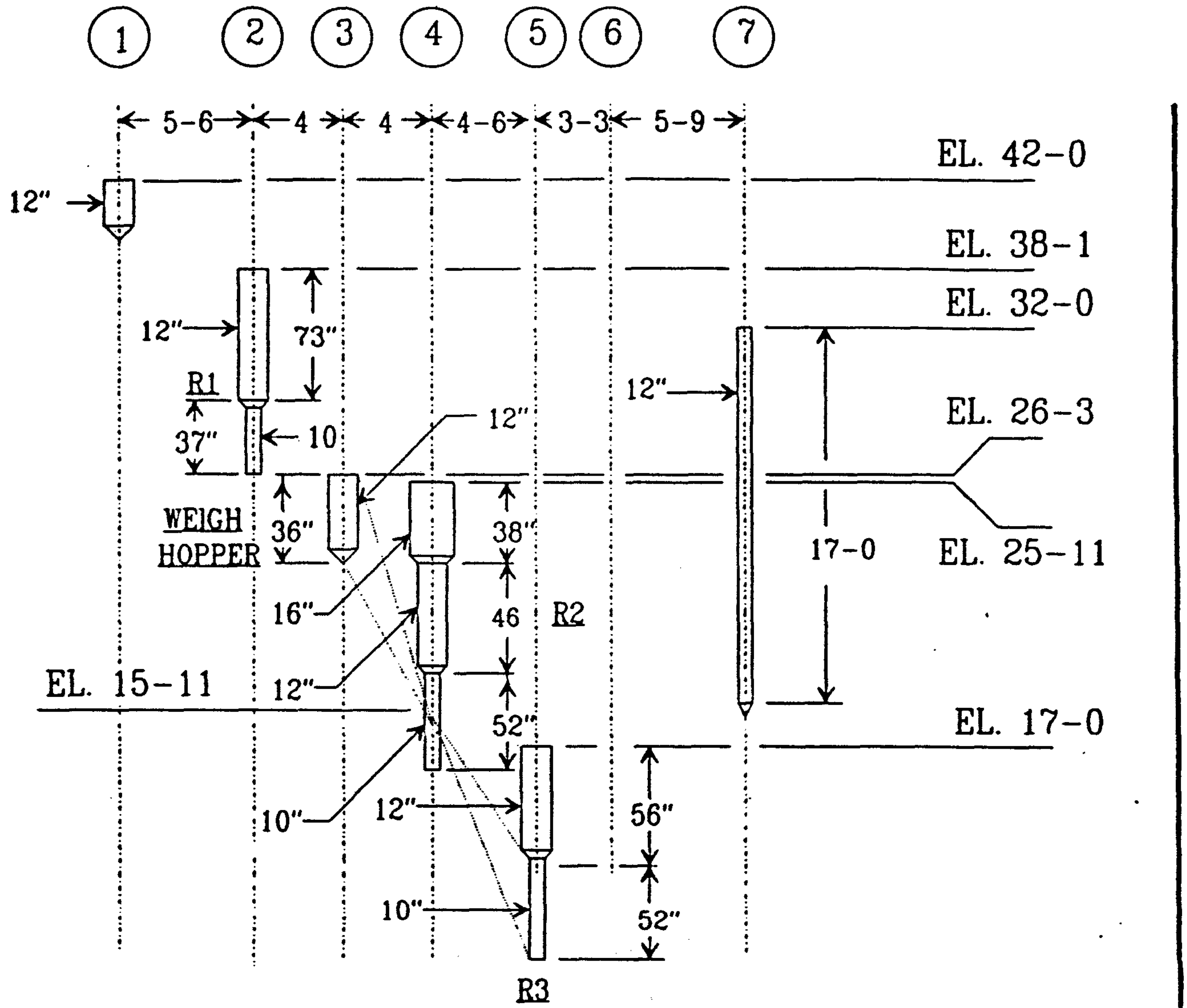
d. Massive Failure of Heating Elements

A massive failure of all heating elements in all furnace sections for any reactor would result in low temperature alarms on all it's controllers and in closing the inlet steam valves to R-2 if the failures were in the R-2 furnaces.

Failure of these "fail-safe" systems could allow condensate to enter the reactor. When liquid water is present near the bottom of a reactor with powder present, the 1/8" holes in the bubble caps will plug. The resulting high feed system pressure would automatically close the steam line and sound an alarm when the pressure reaches 18 psig. Further pressure increase would cause a rupture disc and relief valve to open at 20 psig. Should all the aforementioned fail to shut off the steam supply to R-2, the level of water would rise to the bottom of the lower disengaging section approximately five hours after the onset of condensation (more than eight hours after power loss). It is not credible to assume that this abnormal condition could go undetected for this length of time. Also, this amount of condensate could not collect unless the R-2 powder exit valve sealed and was not opened as required by procedures for unloading to the R-3 reactor at two hour intervals.

The concurrent failures of independent equipment and procedures described in each of these circumstances is deemed incredible.

Figure II.9-1



ref: Dwg. d-5007-2001 Sheet #6
Elevation View
UF 6 -- UO 2 Reactor Line

Figure II.9-2

SCHEMATIC REACTOR DETAILS FOR CRITICALITY CALCULATION

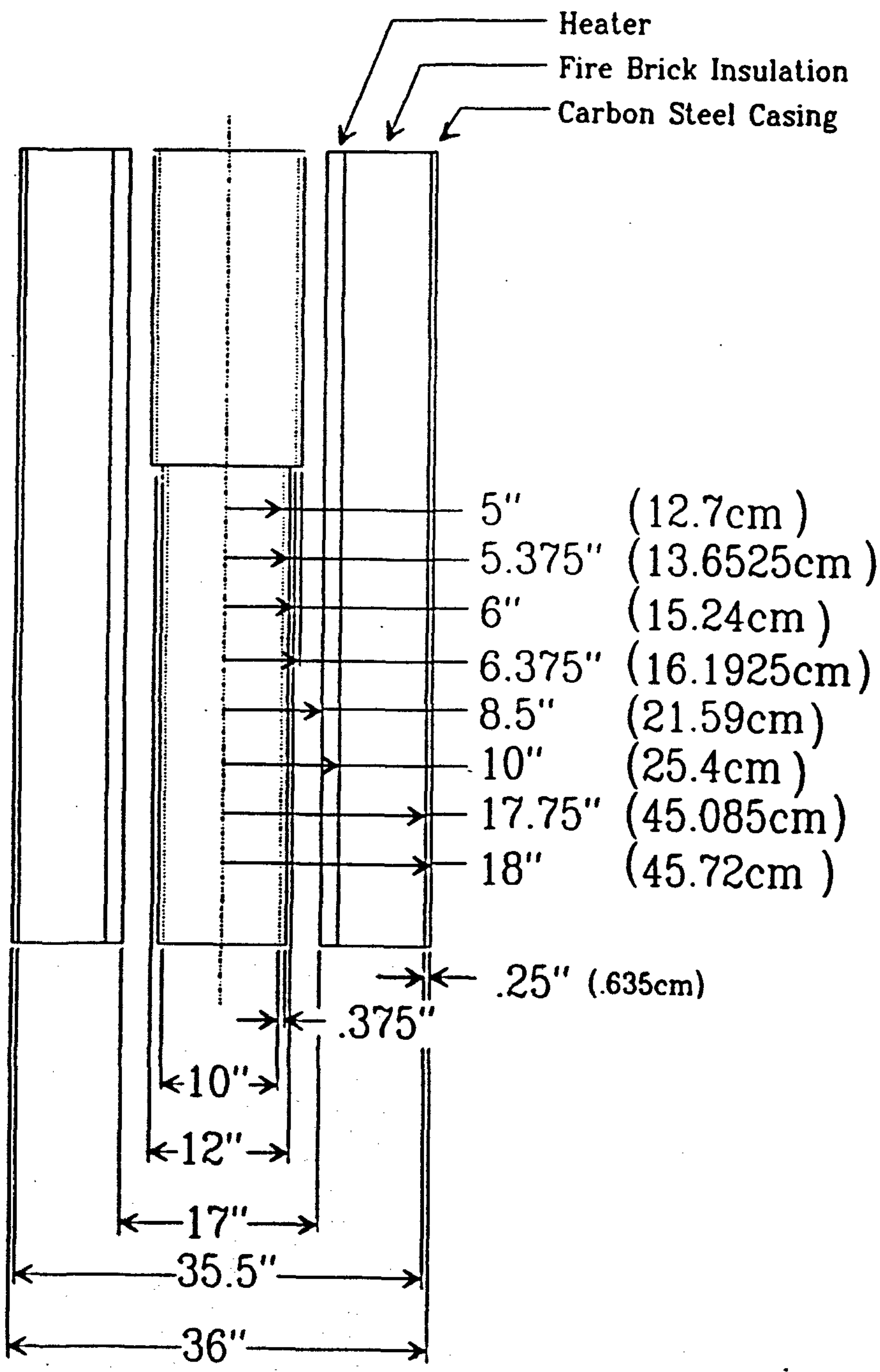
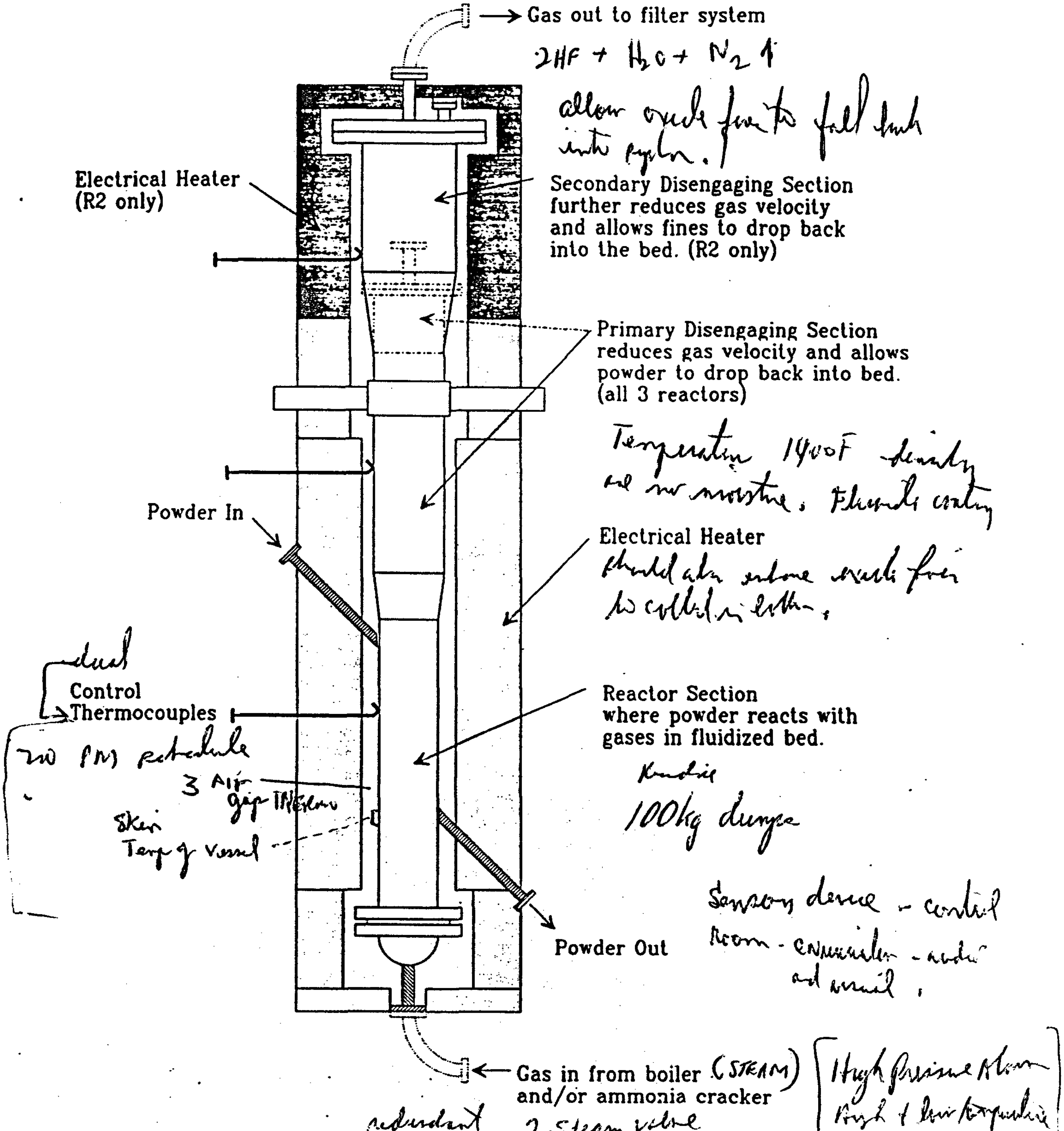


Figure II.9-3



Basic Reactor & Furnace Schematic

9.1 Reactor Vessels and Furnaces (continued)

c. Conclusions (continued)

Nonetheless, a K_{eff} calculation has been made for an isolated R-3 reactor as shown in II.9-2. The K_{eff} = 0.9510 ± .0055. (See page II.9-29)

3) Criticality Safety Analysis The following conservative assumptions were used in the calculational model of the UF_6 to UO_2 conversion equipment analysis:

a) Reactors R-1 and R-2 were assumed to be filled in the 10" portion (i.e., no overfill) with dry UO_2 at 2.5 g/cc density of powder and 5.0 w/o U^{235}. All structures consisting of .375" steel wall, 7.75" of 37.5 lbs/ft^3 firebrick insulation and .25" steel casing were included in the model. The conservative reactor details shown in Figure II.9-2 (page II.9-4) were used.
b) The R-3 reactor was assumed to be filled in both the 10" and 12" portions (i.e., overfilled) with saturated UO_2 at 2.5 g/cc powder density and 5.0 w/o U^{235}. All structures consisting of .375" steel wall, 7.75" firebrick insulation and .25" steel casing were included in the model.
c) The cooler was assumed to contain UO_2 with 5.0 w/o water. The .125" steel walls were also modelled.
d) The silos were assumed to contain UO_2 with 5.0 w/o water. The .125" steel walls were also modelled.
e) The UO_2 blenders contained UO_2 with 5.0 w/o water. The .125" steel walls were also modelled.
f) The UF_6 scrubber was assumed dry UO_2 with no external structures modelled.
g) The R-1 hopper was assumed to be filled with dry UO_2 and surrounded by 1" of water.
h) An external mist of .001 g/cc was assumed.

9.1 Reactor Vessels and Furnaces (continued)

c. Conclusions (continued)

3) Criticality Safety Analysis (continued)

The KENO-IV code with Hansen-Roach cross-sections was used to determine the criticality of the system. The K_{eff} obtained was .9714 ± .0058.

9.2 Cooler

The cooler is an eight inch diameter with an external water jacket. Eight inch diameter is safe at 5.0% enriched. Reference: Section 4.0

9.3 Interaction of the UF_6 - UO_2 Conversion Equipment

These following interaction analysis show that the reactors are the most reactive components in the UF_6 - UO_2 conversion system. Though the reactivity analysis was done for 5.0 w/o U^{235} using KENO, the interaction calculations are still valid and can be used for small changes to the system. Such modifications will be limited to solid angle changes which would not increase the total solid angle.

The interaction of the conversion equipment has been evaluated by the solid angle method. The total solid angle subtended at R-2 by other equipment is 0.70 steradians which slightly exceeds the allowable solid angle of approximately 0.5 steradians. The KENO results verify that the interaction with the R-2 reactor with the other systems did indeed increase the reactivity of the system.

ENCLOSURE III

SPECIAL NUCLEAR MATERIAL LICENSE NO. 33

AMENDMENT REQUEST

CHECK FOR APPLICATION FEE