70-687

UNION CARBIDE

UNION CARBIDE CORPORATION P. O. BOX 324, TUXEDO, NEW YORK 10987
MEDICAL PRODUCTS DIVISION TELEPHONE NUMBER: (914) 351-2131

PDR
Return to 396SS

September 6, 1984

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U. S. NUCLEAR REGULATORY COMMISSION
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U. S. Nuclear Regulatory Commission
Division of Fuel Cycle and Material Safety
Advanced Fuel and Spent Fuel Licensing Branch
7915 Eastern Avenue
Silver Spring, MD 20910

Attn: Leland C. Rouse
Branch Chief

Gentlemen:

Per my discussion with Dr. Clark I have enclosed 6 sets of 12 page changes to the consolidated SNM-639 license renewal application. We understand that these changes reflect the final comments of your office and the Region I office and that the license is now in proper form for renewal.

We have this document stored on word processing equipment and if you want to make changes, we can do it with minimum effort.

We look forward to the renewal of this license. The new format will be mutually easier to administer for the licensor and licensee.

Very truly yours,

James J. McGovern
Business Manager
Radiochemicals

JJMcG:js

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(c) Processes pertinent to criticality or radiation safety, e.g. (target preparation, irradiated target processing, waste processing, packaging).

(d) Operating auxiliary systems and equipment, e.g. (emergency ventilation, off-gas monitor, criticality monitor).

(e) Surveillance checks and calibration of instrumentation.

(f) Implementation of Emergency Plan and Physical Security Plan.

(g) Non-routine operations where radiation safety issues are pertinent and which are not provided with full time Health Physics coverage shall have written procedures.

(h) Non-routine operations which may involve criticality or other process safety issues shall be reviewed by the appropriate safety committee, shall be conducted according to their recommendations and would normally be done according to written procedures.

(i) All processes which involve greater than 15 grams of SNM which have pertinent criticality or radiation safety issues shall be covered by written procedures.

Administrative control of procedures shall be codified. New and revised procedures must be reviewed in accordance with the procedure code. All new procedures and procedural changes that modify the original intent of the procedure shall be reviewed by the Nuclear Safeguards Committee and approved by Level II Management. The operating rules of the Nuclear Safeguards Committee in Chapter 9 give details of this review process.

2.8 INTERNAL AUDITS AND INSPECTIONS

Audits of operations shall be conducted under the direction of the Nuclear Safeguards Committee. Specific audits of operations with SNM shall be as follows:

Subject Audited	Frequency
Management of Measurement QA Program	1 Per Year
Measurement Procedures	" "
SNM Accountability	" "
SNM Criticality	" "[1]
Packaging and Transport of Waste	" "
Radiation Safety	" "
Hot Lab Operation	" "

[1] A thorough criticality safety audit shall be performed by the NSC member who is competent in this area and who is designated as such. A bi-monthly (every 2 months) inspection of all SNM criticality control areas shall be performed by an appointee of the NSC to assure that compliance with criticality limits is maintained in each control area.

3. Facility radiation and contamination surveys where required by applicable regulation and this license.

4. Nuclear Safeguards Committee review of major plant modifications and additions.

5. Nuclear Safeguards Committee review of nuclear criticality evaluations.

6. Records of all license required instrument calibrations.

7. Records of Health Physics training and ALARA findings.

8. SNM criticality training.

The following records shall be retained for at least one requalification cycle or for the length of employment of the individual whichever is less.

1. Training and requalification of licensed operators and personnel authorized to handle SNM. However, records of the most recent complete cycle shall be maintained at all times the individual is employed.

CHAPTER 3 - RADIATION PROTECTION

3.1 SPECIAL ADMINISTRATIVE REQUIREMENTS

3.1.1 Radiation Work Permit Procedures

Radiation work permits are issued whenever:

1. Outside contractors are required to work in a radiation controlled area.
2. Workers not normally assigned to radiation work are likely to be exposed to significant radiation exposure or radioactive contamination.
3. They are required under Section 2.7.

   The Health Physics Department issues and approves radiation work permits.

The work permit will be:

1. Written to specify Health Physics requirements for personnel performing the job.
2. Valid only for the time period specified on the permit.
3. Returned to Health Physics at the end of the job.

3.1.2 ALARA Policy

1. Plant policy requires that all radiation exposures, on or off site, which result from plant operation be kept as low as is reasonably achievable.
2. The General Safety Committee shall include representation from Health Physics and site management and is charged with the responsibility for implementing the ALARA comittment.
3. All employees who routinely work in a radiation controlled area must successfully complete a formal radiation safety training course.
4. All maintenance, repair, replacement, and modification work in a controlled area must be reviewed and approved by Health Physics.

5. All production procedures must be reviewed by NSC for conformance with ALARA concept. Appropriate recommendations will be made to assure compliance.

6. Entrance into a high radiation area requires Health Physics approval.

7. All radiation exposures in excess of 50 percent of the limit shall be reported to management at least quarterly.

8. All jobs with projected radiation exposures exceeding 100 mRem or airborne exposures exceeding 10 MPC-Hours to an employee shall require approval from senior Health Physics staff.

9. At the conclusion of jobs requiring senior Health Physics approval the job shall be reviewed to identify areas requiring improvement.

3.2 TECHNICAL REQUIREMENTS

3.2.1 Access Control

1. Hand and foot counters capable of detecting α and or β-γ radiation as appropriate shall be provided at the routine exits of the facility. Employees shall be required to monitor themselves and report contamination levels above the alarm set points.

2. Areas requiring special protective clothing will be posted by Health Physics.

3. Health Physics approval shall be required for access to a High Radiation Area.

4. A changing room and shower facility shall be provided for personnel. The shower facility shall be used by employees for removal of body contamination as recommended by Health Physics. Contamination levels over significant portions of the body which are above the skin contamination limits of Chapter 12, Section 8.4 shall normally require showering.

3.2.2 Ventilation Requirements

1. Magnahelic pressure drop measuring devices shall be provided on all effluent particulate (HEPA) filters.

2. A magnahelic check of all HEPA filters shall be performed monthly.

(f) The U-235 concentration shall not exceed 250 grams per liter of H_2SO_4 solution.

(g) The hydrogen density in the solution shall be between 75 and 115 g/L.

(h) The size of the storage shelf shall be at least 18 ft^2.

(i) Each batch shall be stored no longer than 60 days.

(j) The raschig rings shall be validated to comply with the specifications of ANSI/ANS 8.5 except that the mechanical shock-resistance test (Para. 4.5) and the maintenance inspections (Sec. 6) shall not be required.

(2) The quantity of SNM in an isotope processing cell shall not exceed 650 gms U-235 provided SNM in excess of 100 gms must be contained in borosilicate glass containers meeting the following criteria:

(a) The volume of individual containers shall not exceed 250 mL.

(b) The concentration of U-235 shall be less than .250 gm/mL.

(c) Containers shall be stored in racks for ease of identity and prevention of damage.

(d) Storage containers shall be composed of borosilicate glass containing $\geq$ 11.8 weight percent B_2O_3.

(e) The size of the storage shelf shall be at least 18 ft^2.

4.2.6 Quantity Limit for SNM in a Waste Storage Hot Cell

SNM in a waste storage hot cell shall be in the following forms. The total shall not exceed 2000 gms U-235 per cell.

(a) Metal cylinders containing no more than 200 gms U-235 in solution per container, having a maximum inside diameter of 5 inches and a maximum height of 12 inches, stored in a linear array of up to 7 cylinders having a maximum edge to edge spacing of 1.34 inches.

(b) Metal cylinders (5" O.D. x 12" H x 1/16 wall) containing no more than 200 gms U-235 solidified in concrete (H/U $\geq$ 1300). This material is from the waste form process. The maximum quantity per 55 gallon (minimum) drum shall be 200 gms.

CHAPTER 6 - SPECIAL PROCESS COMMITMENTS

6.1 EFFLUENT FILTRATION

6.1.1 The overall iodine removal efficiency of hot cell filters shall not be less than 99.5 percent.

6.2 ISOTOPE PROCESSING

6.2.1 The dissolution phase of the isotope separation process for uranium - fueled targets shall not commence if Condition 6.1.1 can not be met.

6.2.2 Changes shall not be made to the isotope separation process which will cause the byproduct and Pu content of the waste to exceed regulatory limits.

6.3 WASTE FORM PROCESS

6.3.1 The calcining phase of the waste form process shall be terminated and not permitted if Condition 6.1.1 can not be met.

6.3.2 There shall be no pressurized liquids having a potential for flooding in a waste storage cell.

6.3.3 Waste Form Material Storage in the gamma facility shall be limited to a period of 2 months per batch.

6.4 WASTE PACKAGING

6.4.1 The facility will package its waste to meet the requirements of 10 CFR 61.56 "Waste Characteristics".

6.4.2 The facility will classify its waste to meet the requirements of 10 CFR 61.55 "Waste Classification".

6.5 URANIUM TARGET PRODUCTION

6.5.1 The licensee shall empty and clean the unsafe geometry container in the waste storage laboratory after each batch of not more than 350 grams of U-235 has been processed through the plating laboratory and shall maintain records showing that the container has been emptied after each 350 gram batch is processed.

CHAPTER 8 - RADIOLOGICAL CONTINGENCY PLAN

Union Carbide shall implement, maintain, and execute the response measures of the Union Carbide Nuclear Facility Emergency Plan submitted to the Commission on September 3, 1982 and revised August 8, 1983, and as may be modified as hereinafter described. Union Carbide shall also maintain procedures for the Emergency Plan to implement the Plan. This Emergency Plan and associated implementing procedures incorporate the emergency planning requirements of 10 CFR 70.22 (i) as they refer to onsite planning and notification procedures. Union Carbide shall make no change in the Emergency Plan that would decrease the response effectiveness of the Plan without prior Commission approval as evidenced by a license amendment. Union Carbide may make changes to the Emergency Plan without prior Commission approval if the changes do not decrease the response that is made to the Plan. Such changes shall be reported to the NRC Regional Office with a copy to the Director of Inspection and Enforcement annually.

15.5 LIMIT FOR SNM IN AN ISOTOPE PROCESSING CELL

(1) The SNM limit for each isotope processing cell is 3000 grams U-235, provided all SNM in excess of 100 grams be contained at a maximum concentration of 250 g U-235 per liter of solution, in borosilicate glass bottles each having a maximum internal volume of 250 mL and packed with borosilicate glass raschig rings having a minimum B_2O_3 content of 11.8 wt-percent, a minimum density of 2.22 g/cm^3 and a maximum outside diameter of 1.50 in. The minimum glass volume fraction within each bottle shall be not less than 28 vol-percent and the hydrogen density in the solution shall be not less than 75 g/L nor greater than 115 g/L.

SNM is typically brought into the isotope processing cell in solid form encapsulated in a metal target. After dissolution in H_2SO_4, the SNM in solution form is transferred through needles into a borated glass bottle with septum fittings. During the extraction of usable isotopes the raw fission waste containing the SNM dilute acid solution is transferred to raschig-ring packed borosilicate-glass bottles which are then stored for a maximum of 60 days in special racks awaiting the waste form process where it is converted to a form acceptable for extracting the SNM from the raw fission waste.

The limit of 100 g U-235 for SNM that is not contained within raschig-ring packed bottles is well below the single parameter limit of 760 g listed in Reference 1.

For raschig-ring packed vessels, Reference 6 gives the maximum concentrations of SNM solutions that may be contained within vessels of unlimited size containing glass rings conforming to the requirements of the Standard. These requirements are:

- B_2O_3 content : 11.8 wt-percent minimum
- density : 2.22 g/cm^3 minimum
- outside diameter : 1.50 in. maximum

For vessels packed with rings conforming to the above requirements, the Standard gives 330 g/L of solution as the maximum concentration of U-235 for a minimum glass to vessel volume ratio of 28 vol-percent. The SNM concentration limit of 250 g/L provides a margin of safety.

passages that have a greater drainage area than the area available for in-leakage of liquid. The upper grid plate of the storage rack serves to confine the tubes to 12" centers, keep moderating material from being placed between storage tubes, and prevent other containers from being suspended in the storage array. In the same manner, a lower grid structure maintains the required spacing of the bottoms of the storage tubes. The structure is supported and braced so as to support the dead weight of the fully loaded rack, plus the combined operational and accidential forces that could possibly exist in the cell, with a margin of safety greater than 3.

15.7.2 Criticality Safety Analysis of a Waste Form Process Cell

General Approach

The criticality safety analysis uses the surface density method presented in Section 4.23 of Reference 1. The individual mass units are assumed to be spherical masses in an ordered array on a single plane. Each mass unit is centered in a planar unit cell with the boundaries of adjacent unit cells touching. This method constitutes a conservative treatment since the third dimension is ignored. In the actual geometry, the third dimension provides a great deal of dispersion and, therefore, a reduction in the reactivity of the array.

Numerous factors of conservatism are built into the safety analysis for the following reasons:

- To give a wide margin of safety
- To allow for contingencies
- To make simplifying assumptions, thereby avoiding lengthy calculations or complicated experiments.
- To provide margins that, at a later date, can be converted to increased limits in the existing geometries with the appropriate analysis and license approval.

Table 15-2 is a summary of the license conditions, the assumptions which form the bases for the safety analysis, and the actual conditions expected to exist in the WFP.

Table 15-1
Determination of Minimum Unit Cell Dimension

C (g U/cm^3)	T Slab (cm)	σ_o	M (Kg)	Unit Cell Dimension, d (in) m = 400 g	m = 600 g
.013	40.	.52	40.	19.5	24.0
.014	35.	.49	10.	20.6	25.6
.02	19.	.38	2.6	25.5	33.6
.03	13.	.39	1.6	27.6	39.4
.04	10.3	.41	1.4	28.0	41.6
.05	9.0	.49	1.4	26.8	39.8
.06	8.0	.48	1.5	25.4	36.8
.08	7.0	.56	1.6	23.1	32.9
.10	6.3	.63	1.8	21.1	29.3
.20	5.0	1.00	3.0	15.4	20.1
.50	4.3	2.15	7.	9.9	12.4
1.00	4.2	4.20	12.	7.0	8.7

$$d = 13.7 \left[\frac{nm}{.6\,\sigma_o\,(1 - 1.37\,f)}\right]^{.5}$$

(Ref. 1, Sec. 4.23 where d is in mm and m is in gm)

Changing the units and substituting for σ_o and f;

$$d = 22.1\ [\ (m/C/T)/\ (1-1.37\ m/M)]^{.5}\ \ (in)$$

where: C = U-235 concentration (g U/cm^3)

T = minimum water reflected slab thickness, Figure 2.4 of Reference 1 (cm)

M = Critical mass of an unreflected sphere, Figure 8 of Reference 2 (kg)

m = mass of individual units of fissile material being analyzed (kg)

n = no. of units = 1

.6 = surface density reduction factor for concrete (Ref. 1, Section 4.27)

σ_o= surface density = C x T (gm/cm^2)

f = m/M

15.8 LIMIT FOR SNM IN GAMMA PIT

The WFP containers, each loaded with less than 200 gms of dry UO_2 (H/U not more than 20), are stored in the processing cell as containers are accumulated to fill a shipping cask. WFP containers are then moved to the water filled gamma pit where they are stored temporarily prior to being loaded into the shipping cask.

The storage rack in the gamma pit is designed to accept the 3" ID maximum WFP containers stacked with a 12" minimum wall-to-wall separation between containers. Barriers keep containers from being placed between storage positions or within 12" of the storage array. The rack is of rigid construction so as to withstand potential forces which could significantly reduce the safety margin of the array. Ref. 1, Fig. 2.1 shows that spherical metal-water mixtures of U with H/U $\leq$ 20 are subcritical up to 5 kg with 300 mm water reflection and therefore three containers (< 200 gm) can be stacked end-to-end without forming a critical unit. The 12" of water between container walls effectively decouples the units from one another (Reference 7). Thus two containers in each storage location plus one passing over will remain subcritical.

The WFP containers are constructed entirely of aluminum. The gamma pit joins the reactor pool, forming a common body of water. The aluminum clad, plate-type reactor fuel elements perform reliably after years of storage and use in the same water. Corrosion of the aluminum WFP container during its relatively short term of storage therefore does not require a time limitation.

15.9 LIMIT FOR SNM IN WASTE STORAGE FACILITY

The waste storage facility consists of a honeycomb matrix of 100 storage cells. The storage cells are 28" in diameter in a triangular array, with 10" of concrete separating adjacent storage cell at the closest proximity. Because of the level of radioactivity in the waste container, a minimum of 4 ft. of concrete shielding is provided on all exterior surfaces of the storage facility. Shield plugs in the individual pits form the operating floor. The waste stored in the facility is packaged to meet DOT and waste burial site requirements. The amount of SNM is limited to 350 grams of U-235 per cell. This is a known safe quantity for an individual unit in that it is less than one-half of the single parameter limit.

The storage cell planar array provides an average unit cell spacing $\geq$ 38 inches center to center. The material stored in these drums would have the same constraints as that material described in paragraph 15.6.3 (i.e. 200 $\geq$ H/U $\geq$ 1300). The surface density analog for infinite planar arrays (Ref. Table 15-1) shows the most reactive form of this material (i.e. least allowed surface density) to be the U waste form process waste with H/U $\geq$ 1300. If all 350 gms in each storage cell consisted of this material the allowed unit cell spacing by the surface density method would be 23.4 inches. This is well below the average spacing provided by the storage facility. It is possible theoretically that two adjacent cells could have 350 gms each separated by as little as 15" but the other closest units in adjacent cells of the array would be separated more than the allowed 23.4 inches.

This configuration is considered to be conservative because:

(a) The storage cells are constructed to prevent flooding from external water. The drainage system under the storage array is equipped with an alarm in the event flooding does occur. There is no water service piping to this part of the building thereby eliminating the occasion of flooding caused by internal water sources.

(b) Individual units within drums shall have less than 250 gms as limited by the license conditions of Section 15.6. Additional material ($\leq$ 100 gms) would have to be located in another drum in the cell. In practice, the waste form process waste will contain approximately 15 gms U-235 per cylinder within a drum and the Raw Fission Product Waste will have < 175 gms per container. These quantities are limited by the original concentration of U solutions prior to mixing in concrete. Since it is not practicable to have 350 gms come together in a single unit in a waste storage cell, the minimum effective cell spacing between the two closest units becomes greater than the theoretical 15 inches. Conversely when the actual U characteristics that exist in the processes (i.e. 20 gms/cylinder waste form material and 250 gms/cylinder raw fission product waste) are used in the surface density method, the allowable separation distance between units in a planar array become 5 inches and 13.44 inches respectively.

(c) An independent analysis was performed in support of amendment No. 7 to this license dated 11/30/81 by KENO calculations which showed the maximum safe surface density to be 200 gms U-235/ft^2. The surface density of this array is < 60 gm/ft^2 (Ref. 10).

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CONTROL NO. 24086

DATE OF DOC. 09/06/84

DATE RCVD. 09/07/84

FCUF ____ PDR ✓

FCAF ✓ LPDR ____

WM ____ I&E REF. ✓

WMUR ____ SAFEGUARDS ✓

FCTC ____ OTHER ____

DESCRIPTION:

Changes to the Consolidated license application for renewal

09/07/84 INITIAL CEC