

RECORD OF REVISION

PROCEDURE

If there are changes to the procedure, the revision number increases by one. These changes are indicated in the left margin of the body by an arrow (>) at the beginning of the paragraph that contains a change.

Example:

> The arrow in the margin indicates a change.

UNCONTROLLED

| Rev. No. | Description of Changes   | Revision On<br>Page(s) | Dated |
|----------|--------------------------|------------------------|-------|
| 0        | Original Issue           | All                    |       |
| 1        | Dated 5/20/88            | All                    |       |
| 1        | Engineering Release 1430 | N/A                    | 8/88  |
| 2        | Per ECN 3353             | Page 4                 | 1/90  |

RECORD OF REVISION (CONTINUATION SHEET)

| Rev. No. | Description of Changes | Revision on<br>Page(s) |
|----------|------------------------|------------------------|
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UNCONTROLLED

OSR/GP-7  
Rev. 2

|                    |   |                      |
|--------------------|---|----------------------|
| TYPE:<br>OSR [X]   | TITLE: Criticality Safety for Liquid<br>Transfers | NUMBER: GENPLNT<br>7 |
| Tech. Reqmn't. [ ] |   |                      |

CRITERIA: 1. Prevent Criticality

UNACCEPTABLE EVENTS: 1. Inadvertent criticality.

|                       |   |                         |                     |
|-----------------------|---|-------------------------|---------------------|
| Safety Limit          | X | Reporting Requirements: | DOE-ID CONTROLLED   |
| LCO                   | X | UOR                     |                     |
| LCS                   |   |                         |                     |
| Surveillance Reqmn't. | X |                         |                     |
| Tech. Requirement     |   |                         | DOE-WVPO CONTROLLED |
| Operating Limit       |   |                         | WVNS CONTROLLED     |

>IMPLEMENTING PROCEDURES:

EP 007  
EP 008  
EP 011  
SOP 7-8  
SOP 71-1  
SOP 71-2  
SOP 71-6  
SOP 71-16

LLK0130:3RM-1

OPERATIONAL SAFETY REQUIREMENTS

CRITICALITY SAFETY FOR LIQUID TRANSFERS

UNCONTROLLED

APPLICABILITY

This requirement applies to all liquid transfers of fissile material at the WVDP except for transfers of decontaminated supernatant within the IRTS system.

OBJECTIVE

The objective of this requirement is to assure that all liquid transfers of fissile material are conducted in a manner which has no potential for an inadvertent criticality.

SPECIFICATIONS

SAFETY LIMIT

NO LIQUID TRANSFERS SHALL BE MADE THAT WILL RESULT IN EXCEEDING A  $k_{eff}$  OF GREATER THAN 0.95.

LIMITING CONDITIONS FOR OPERATIONS

1. FOR UNRESTRICTED AND 'UNLIMITED LIQUID BATCH TRANSFERS, FISSILE MATERIAL CONCENTRATION SHALL NOT EXCEED THE VALUES LISTED IN TABLE 1.
2. SAMPLING AND ANALYSIS IS THE PREFERRED METHOD TO VERIFY FISSILE CONCENTRATION. HOWEVER, VERIFICATION MAY BE BY USE OF PREVIOUS DOCUMENTATION WHICH IS TRACEABLE TO SAMPLE ANALYSIS. IF THE FISSILE MATERIAL CONCENTRATION OF A TANK IS VERIFIED BY MEANS OTHER THAN DIRECT SAMPLING AND THE TANK IS PART OF A SYSTEM INTO WHICH FISSILE MATERIAL HAD BEEN TRANSFERRED OR THE TANK IS PART OF AN ACTIVE WASTE SYSTEM IN WHICH FISSILE MATERIAL IS SUSPECTED PRESENT, WRITTEN CONCURRENCE AND/O AUTHORIZATION OF THE RADIATION AND SAFE MANAGER SHALL BE REQUIRED PRIOR TO TRANSFER. IN ADDITION, THE SYSTEM MUST BE ANALYZED TO ENSURE THAT PROCESSING WILL NOT CONCENTRATE FISSILE MATERIAL BEYOND THE LIMITS SPECIFIED IN TABLE 1 AND THAT SAMPLES DRAWN ARE REPRESENTATIVE OF THE ENTIRE VESSEL CONTENTS.

SURVEILLANCE REQUIREMENT:

FISSILE CONCENTRATION SHALL BE VERIFIED BEFORE EACH TRANSFER AND SHALL INCLUDE, AS MINIMUM, DETERMINATION OF THE FISSILE MATERIAL CONCENTRATIONS OF BOTH THE "SENDING" AND "RECEIVING" TANKS WHICH COULD POTENTIALLY CONTAIN FISSILE MATERIAL. FOR UNINTERRUPTED BATCH TRANSFERS OR OTHER ROUTINE TRANSFERS WHERE THE FISSILE CONCENTRATION IN EACH INTERMEDIATE AND RECEIVING TANK HAS BEEN PREVIOUSLY VERIFIED TO MEET TABLE 1 REQUIREMENTS, ONLY THE SENDING TANK MUST BE SAMPLED AS A CONDITION FOR FUTURE TRANSFERS. IN ADDITION, THE SYSTEM MUST BE ANALYZED TO ENSURE THAT PROCESSING WILL NOT PRECIPITATE FISSILE MATERIAL OUT OF SOLUTION.

RECOVERY:

IF SAMPLE ANALYSIS RESULTS OR OTHER DOCUMENTATION SHOW FISSILE MATERIAL CONCENTRATIONS THAT EQUAL OR EXCEED THOSE SPECIFIED IN TABLE 1, THE TRANSFER SHALL NOT PROCEED.

BASIS

A modified one group (thermal neutron system approximation with correction for slowing down, Fermi Age Theory) was used in the calculation for conservative results. The critical solution concentration of Pu-239 was determined as a function of U-235 concentration. This eliminates the need for determining the U-235 concentration as a function of uranium solution enrichment, which is more difficult since the solution stream concentration will have to be known or estimated. For the purpose of these calculations, the U-235 concentration was allowed to vary from zero to 4.0 g/L, U-235.

This analysis is conservative for aqueous liquids since they constitute highly thermalized systems. The geometry of all available vessels and sumps in the plant (including those planned for STS, LWTs, and CSS) was analyzed, and the most limiting safe concentration values were determined. These are listed in Table 1. Analysis of potential criticality in the SAR for STS indicates no identified concentrating factors exist and thus no potential for criticality from liquid transfers within ST or between STS and LWTs exists. No potential for criticality within Tank 8D-2. No potential for criticality as a result of tank to tank transfers within IRTS. No potential for criticality in STS as a result of concentration in Prefilter or IX columns (reference memo - K. O'Ahoofe). No potential for criticality within LWTs as a result of concentration in evaporator (reference SAR Volume IV, Part No potential for concentration identified for CSS (reference SAR V Volume Part G). All sumps, drains, collection points were analyzed.

#### ATTACHMENTS

Table 1 - Criteria for Determining the Allowable Fissile Solution Concentrations for Plant Solution Transfers - Taken from Table 5.3 of FB:85:0150.

#### REFERENCES

FB:85:0072 "CSS Criticality Safety Evaluation" K. A. O'Ahoofe memo to J. C. Cwynar, dated March 26, 1985.

FB:85:0150 "Allowable Fissile Material Solution Concentration for Liquid Transfers, Revision 1, dated July 2, 1985.

WVDP SAR, Vol. IV, Part H, Liquid Waste Treatment System

WVDP SAR, Vol. III, Part D, Supernatant Treatment System

WVDP SAR, Vol. IV, Part G, Cement Solidification System

OTHER APPLICABLE OSRS

OSR GP-12 Fissile Material Limits and Requirements for Radioactive Waste  
Packages

OSR GP-11 Storage Canister Loading and Spacing

TABLE 1

CRITERIA FOR DETERMINING THE ALLOWABLE FISSILE SOLUTION  
CONCENTRATIONS FOR PLANT SOLUTION TRANSFERS<sup>(1)</sup>

| <u>Column 1</u>   |                    | <u>Column 2</u>  |
|---|--------------------|--|
| <u>Concentration of Uranium</u><br><u>(U-233 + U-235)</u> |                    | <u>Corresponding Maximum Plutonium</u><br><u>Concentration (Pu-239 + Pu-241)</u> |
| <u>grams/litre</u>  |                    | <u>grams/litre</u>   |
| Greater Than  | But Less Than      | Greater than 1.85 <sup>(2)</sup>   |
| 0.  | 0.049              | 1.85   |
| 0.05  | 0.499              | 1.63   |
| 0.5   | 0.99               | 1.39   |
| 1.0   | 1.99               | 0.90   |
| 2.0   | 2.49               | 0.68   |
| 2.5   | 2.99               | 0.44   |
| 3.0   | 3.49               | 0.19   |
| Greater Than  | 3.5 <sup>(2)</sup> |  |

(1) Column 1 is the total concentration of fissile uranium and Column 2 is the corresponding allowable total fissile plutonium concentration. For a sample containing a combined U-235 plus U-233 concentration in the range shown in Column 1, the corresponding value in Column 2 is the limiting and allowable combined Pu-239 plus Pu-241 concentration for safe processing.

(2) Not authorized for processing. Special written authorization of the Radiation and Safety Committee is required.