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NRC-00-11

March 21, 2000

U. S. Nuclear Regulatory Commission
ATTN: Mr. Harry Felsher
Licensing Section 1, Licensing Branch
FCS&S Division, NMSS
11545 Rockville Pike
Mail Stop T8D14
Rockville, MD 20852-2738

Dear Mr. Felsher:

SUBJECT: SAFE GEOMETRY DISSOLVER SYSTEM LICENSE ANNEX (TAC NO. L31138) CHANGE

In accordance with our facsimile commitment of February 23, 2000 (copy attached), changed pages to the License Annex for the Safe Geometry Dissolver system are hereby submitted.

The only substantive change was the addition of crystalline UNH as an acceptable material form in the Safe Geometry Dissolver. NCS analysis determined that crystalline UNH is bounded by the previous analyses of the system. No criticality controls were affected. If you have any questions, please contact me at (803) 647-1000, Extension 3393.

Sincerely,

WESTINGHOUSE ELECTRIC COMPANY

Robert A. Williams
Licensing Project Manager
Westinghouse Columbia Plant

Docket 70-1151 License SNM-1107

Attachment

NMSS01 Public

Williams, Robert A.

From: Williams, Robert A.
Sent: Wednesday, February 23, 2000 9:56 AM
To: 'hdf@nrc.gov'
Cc: Goldbach, Donald C.; Mixon, Daisy O; Williams, David W.
Subject: INTENT TO CHANGE LICENSE ANNEX

On February 22, 2000, Westinghouse Columbia Fuel Fabrication Facility (CFFF) Regulatory Management apprroved a project that will require a change to the License Annex submitted in support of the Safe Geometry Dissolver System Integrated Safety Assessment (TAC No. L31138).

Project Description

This change is to cover shipment receipt, receipts unloading, container transfer, and re-loading of shipment overpacks into transport containers or truck trailers for return of, shipments of UO2, U3O8 and **UNH Crystals** from outside sources, into Dock 3 in the URRS Area. Such shipments are to be an on-going source of alternate uranium supplies.

Regulatory Review

Project approved for startup and operation (by Manager; Environment, Health and Safety).

Necessary changed pages to the License Annex for the Safe Geometry Dissolver System will be submitted on (or about) March 22, 2000. (ACTION: **DAVE WILLIAMS**, **DAISY MIXON**)

Licensing Project Manager
Westinghouse CFFF

Robert A. Williams

ISA LICENSE ANNEX

SAFE GEOMETRY DISSOLVER SYSTEM

ISA LICENSE ANNEX

SAFE GEOMETRY DISSOLVER SYSTEM

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ISA LICENSE ANNEX

SAFE GEOMETRY DISSOLVER SYSTEM

REVISION RECORD

REVISION NUMBER	DATE OF REVISION	PAGES REVISED	REVISION RECORD
01	03-21-00	1	Add UNH Crystal

ISA LICENSE ANNEX

SAFE GEOMETRY DISSOLVER SYSTEM

Process Summary

The Columbia Fuel Fabrication Facility utilizes an ADU conversion process to produce a ceramic grade uranium oxide powder. The multi-staged ADU conversion process is designed to convert uranium hexafluoride into uranium dioxide powder. During this process, two broad categories of off-stream uranium-bearing solids are generated. They are referred to as "clean scrap" and "dirty scrap." The uranium that is collected as scrap throughout the manufacturing process is dissolved in nitric acid, producing an intermediate product, uranyl nitrate (UN). The UN is eventually converted to a usable uranium oxide powder using the same ADU conversion process as for uranium hexafluoride. The scrap solids are dissolved in one of three safe geometry dissolver systems which are installed adjacent to the Solvent Extraction area. Two of the dissolver systems are primarily for "clean scrap" and the third is for "dirty scrap." The key components of each system are horizontally mounted contactors in which the solids are mixed with a heated nitric acid (HNO_3)/ water mixture for dissolution. The contactors and all associated intermediate vessels are of safe geometry size.

The "clean scrap" dissolvers feature a single contactor for each system. Feed material for these dissolvers is clean scrap U_3O_8 or crystalline UNH which dissolves completely with almost no residue forming UN solution clean enough for immediate use in ADU conversion. Solids, nitric acid, and water are metered into each contactor continuously while a slow-turning paddle agitator mixes the inputs. Solution produced at the dissolvers is collected in safe geometry intermediate storage vessels, analyzed for ^{235}U and free HNO_3 contents, then pumped to UN bulk storage tanks. The maximum allowed ^{235}U concentration is 5.0 $g^{235}U/l$ and the minimum allowed free HNO_3 is 4 weight percent in the UN solution analyses before pumping it to bulk storage. Pumpouts are also continuously monitored by gamma monitors.

The "dirty scrap" dissolver features a set of three interconnected contactors. The three contactors are arranged to provide for uranium dissolution and also for separation and water washing of insoluble residues, which are a substantial part of "dirty scrap" feed materials. Incinerator ash is the primary solid feed material for this dissolver. UN solution from this dissolver contains high levels of impurities and it must be purified via solvent extraction before it can be returned to the ADU conversion process. The impure UN solution is pumped directly from intermediate safe geometry dissolver vessels to other safe geometry process vessels in the Solvent Extraction area. Residues are dried in Blue-M ovens in the Fluoride Stripping area and either recycled through the dissolver for further uranium recovery, or put into drums for burial disposal.

Key drawings and procedures for these Safe Geometry Dissolver Systems are identified in the tables below:

CLEAN SCRAP DISSOLVERS

DRAWING TITLE	DRAWING NO.	SHEET	REV.
Process Flow Diagram	301F08PI01	01 of 02	1
Process Flow Diagram	301F08PI01	02 of 02	1
Counter-Current Contactor CCC-730	301F08PI02	01 of 01	1
Counter-Current Contactor CCC-740	301F08PI03	01 of 01	1

PROCEDURE NO.	REV.	TITLE
COP-836024	1	C4 Dissolvers-Initial Solution Charging
COP-836025	4	C4 Dissolvers-Clean Dissolver Startup and Operation

DIRTY SCRAP DISSOLVERS

DRAWING TITLE	DRAAWING NO.	SHEET	REV.
Process Flow Diagram	301F09PI01	01 of 02	1
Process Flow Diagram	301F09PI01	02 of 02	1
Counter-Current Contactor CCC-750	301F09PI02	01 of 01	1

PROCEDURE NO.	REV.	TITLE
COP-836024	1	C4 Dissolvers-Initial Solution Charging
COP-836027	3	C4 Dissolvers-Dirty Dissolver Startup and Operation
COP-836028	4	C4 Dissolvers-Dirty Dissolver Press Cleanout and Residue Processing

Environmental Protection and Radiation Safety Controls

Adequate controls have been established for postulated environmental and radiation safety accident sequences for the URRS Safe Geometry Dissolver System. Controls include various administrative controls, monitors, equipment design, filtration, scrubbers, interlocks, and passive controls. Appropriate regulatory and maintenance surveillance is performed to assure that the systems and controls are functional. These combined engineered, administrative, and passive controls assure that appropriate safeguards for radiation safety and environmental control have been implemented. The site location and inherently large diffusion factors would further mitigate any potential off-site environmental and radiation safety effects.

TABLE 1

ENVIRONMENTAL AND RADIATION ACCIDENT SEQUENCE ANALYSIS

ACCIDENT SEQUENCES	CONTROL	CLASS, MARGIN
1. Powder spill in polypak transfer/elevated airborne	Hybrid glovebox with automated remote dump. Integral gloves. Building functions as a secondary containment. Respiratory protection and other PPE available.	C, Adequate
2. Glove failure/elevated airborne	Administratively examine glove prior to use. Building functions as a secondary containment. Respiratory protection and other PPE available.	C, Adequate
3. Plugged HEPA filter/loss of ventilation	Duct system alarmed. Alternate fans activated and switch to standby HEPA ventilation system. Respiratory protection and other PPE available.	C, Adequate
4. Line rupture/acid or UN leak	System interlocked to fail safe position. High level in CCC stops all material feeds. Nitric acid addition can be terminated by TDC or in the field by manual block valve. No drains in corrosion resistant floors. PPE available.	C, Adequate
5. Spill or leak in product hold tanks	Tank corrosion resistant stainless steel. No drains in corrosion resistant floors. SCBA and other PPE available.	C, Adequate
6. Tank over pressurization/overflows	T-747 overflow tank equipped with high level alarms which will terminate all additions remotely by TDC. PPE available.	C, Adequate

Nuclear Criticality Safety (NCS) Controls and Fault Trees

Control Parameters and Safety Limits:

<u>Control Parameters</u>

Dissolver Input Hood (3)
- mass
- moderator

Waste Residue Discharge Hood Overflow Chute (3)
- mass (material available to overflow chute)
- geometry (level)

Favorable Geometry Tanks and Vessels
- geometry

Filter Presses (2) and Cartridge Filters
- geometry

<u>Safety Limits</u>
- See Table 5.3-2 - Feed Hood Components
- See Table 5.3-3 - Wet Residue Overflow Chute
- See Table 5.3-4 - Spacing Interaction for favorable geometry vessels, and individual cylinders diameters with either UO_2 or uranyl nitrate

Bounding Assumptions: (From Table in SNM-1107)
- Homogeneous UO_2 for feed hoods, filter presses, and wet residue discharge canister/overflow chute and pack
- Uranyl Nitrate - $UO_2(NO_3)_2$ for vessels
- Optimum H_2O moderation
- Partial Reflection
- 5.0 wt% enrichment
- No neutron absorbers in system

Controls

<u>Safety Significant Controls</u>

The "X" in the controls below indicates that the control exists for all three dissolvers. Otherwise, the number indicates to which dissolver the control applies: the clean dissolvers (#1 and #2) or the dirty dissolver (#3). The one exception to the numbering

convention is active engineered control SGD-3-10, which refers to the clean dissolver systems' single overflow tank.

Passive engineered controls (PEC)

Passive engineered controls are described in the License and in Regulatory Affairs-108. The requirements for functional verification are determined from this evaluation.

P-SGD-X-01	Feeder Lower Ventilation Enclosure Weep Holes	verification not necessary - constantly attended	IE# SGDS 12
P-SGD-X-02	Dissolver Input Hood Side Openings	verification not necessary - constantly attended	IE# SGDS 13
P-SGD-X-03	Wet Residue Discharge Chute Hinged Overflow Flap	verify quarterly	IE# SGDS 17
P-SGD-X-04	Wet Residue Discharge Chute Fixed Gap (1- 1½ inch) Between Chute and Pack	verify quarterly	IE# SGDS 17
P-SGD-X-05	Large residue discharge line precludes pluggage	verification not necessary - clear line needed for operation	IE# SGDS 3
P-SGD-X-06	Volumetric Feeder Integrity	verification not necessary	IE# SGDS 1 IE# SGDS 11

Active engineered controls (AEC)

Active Engineered Controls are defined in the License and in Regulatory Affairs Procedure RA-108. They are also called safety significant interlocks The requirements for functional verification are defined in RA-108 and/or area operating procedures.

SGD-X-07	Wet Residue Discharge Canister Proximity Switch	IE# SGDS 15
SGD-X-08	Wet Residue Discharge Canister High Level Probe	IE# SGDS 16
SGD-X-09	Wet Residue Discharge Line High Level Probe	IE# SGDS 16
SGD-1-10	Clean Dissolvers Overflow Tank High Level Interlock (LSHH-747B)	IE# SGDS 8
SGD-X-12	CCC High Level Interlock	IE# SGDS 4

Administrative controls with computer or alarm assist (AC)

Administrative controls with computer or alarm assist (AC) typically consist of operator actions that are prompted or assisted by computer output. The requirements for functional verification are determined by this evaluation.

- none

Administrative controls

Safety Significant administrative controls are required operator actions that usually occur without prompting from a computer/control panel alarm or indication. These controls may

require documentation via Control Form or some other record. Functional verification is not normally required.

A-SGD-01	Operators must not overfill the feed hopper and dissolver input hood material	COP-836025, COP-836027 and Criticality Posting URRS-26 limiting the feed hoods to one pack	IE# SGDS 2
A-SGD-02	Operators check motor housing and ventilation enclosure for material accumulation	COP-836025, COP-836027	IE# SGDS 18

Margin of Safety

The nuclear criticality margin of safety for the safe geometry dissolver system is evaluated to be very strong. Calculations indicate that keff ≤ 0.95 for all normal operating conditions. Further, for any credible process upset, $k_{eff} \leq 0.98$.

The parameters that directly affect neutron multiplication for the safe geometry dissolver system, assuming 5.0 wt% ^{235}U enrichment, are listed above. A criticality would be possible in the safe geometry dissolver system given the following:

dissolver input hood, feed motor housing, or ventilation enclosure

- 49 kg UO_2 accumulates inside any of the three, and greater than 20 liters of moderator (water from outside or solution from the dissolver system) enters any of the three, and greater than a 6 inch slab of moderated material forms.

wet residue discharge hoods overflow chute

- 49 kg UO_2 gets into the wet residue discharge hood due to failure of the dissolving system, and the material accumulates in the overflow chute such that a critical configuration (16.5 inch accumulation) is formed.

dissolver system vessels, tanks, cartridge filters, and filter presses

- Vessels are replaced with nonfavorable geometry vessels and are filled with optimum material.

Summary Of Initiating Events Which Lead To Credible Process Upsets

Group 1 Defense Elements - Mass Defense For Feed Hood and Enclosure

IE# SGDS 1 Volumetric Feed Hopper Integrity Fails
IE# SGDS 2 Dissolver input hood Overfilled
IE# SGDS 18 URRS Operator Fails to Detect Material Accumulation in Motor Feed Housing or Ventilation Enclosure
IE# SGDS 19 Operators Fail to Screen Material

Group 2 Defense Elements - Moderator Defense For Dissolver input hood, Feed Hopper, and Ventilation Enclosure

IE# SGDS 3 CCC Plugs

IE# SGDS 4	High Solution Level in CCC
IE# SGDS 5	Clean Dissolver Product Dilution Tank Overfills and Backs Up
IE# SGDS 6	Clean or Dirty Dissolver Product Collection Tank Overfills and Backs Up
IE# SGDS 7	Clean Dissolver Product Hold Tank Overfills and Backs Up
IE# SGDS 8	Clean or Dirty Dissolver Product Overflow Tank Overfills and Backs Up
IE# SGDS 9	Dirty Dissolver Wash Water Collection Tank Overfills and Backs Up
IE# SGDS 10	Dissolver Solution Backflow Into Volumetric Feeder

Group 3 Defense Elements - Accumulation Defense For Feed Hood Assembly

IE# SGDS 11	Accumulation in Motor Feed Housing
IE# SGDS 12	Accumulation in Ventilation Enclosure
IE# SGDS 13	Accumulation in Dissolver input hood

Group 4 Defense Elements - Mass Defense For Wet Residue Overflow Chute

IE# SGDS 14	Sufficient SNM Available to Wet Residue Overflow Chute
IE# SGDS 15	No Discharge Canister in Place in Discharge Hood
IE# SGDS 16	Undissolved Solids Accumulate in Discharge Line

Group 5 Defense Elements - Geometry Defense For Wet Residue Overflow Chute

IE# SGDS 17	Undissolved Solids Accumulate in Overflow Chute

Table 5.3-2: Nuclear Criticality Safety Limits for k_{eff} 0.90, 0.95, and 1.00 for the Safe Geometry Dissolver System Feed Hood

PARAMETER	NORMAL OPERATING CONDITIONS	BOUNDING ASSUMPTION	CRITICALITY SAFETY LIMIT ≤ 0.90	CRITICALITY SAFETY LIMIT ≤ 0.95	CRITICALITY LIMIT ≤ 1.00
^{235}U MASS	Feed Hopper Full No Material in dissolver input hood, Feed Motor Housing, or Ventilation Enclosure	Unrestricted UO2	27.6 kg UO2 Minimum Critical Spherical From CRI-94-049	36.6 kg UO2 Minimum Critical Spherical From CRI-94-049	49.2 kg UO2 Minimum Critical Spherical From CRI-94-049
MODERATOR/ CONCENTRATION	None	Optimum Moderation	Not Controlled	Not Controlled	Not Controlled
GEOMETRY	Nonfavorable Geometry	Nonfavorable Geometry	4 inch Slab Entire Hood Minimum Infinite From CRI-94-052	5.6 inch Slab Entire Hood Minimum Infinite From CRI-94-052	6.3 inch Slab Entire Hood Minimum Infinite From CRI-94-052
SPACING	N/A	N/A			
DENSITY	Homogeneous UO2•H2O	Homogeneous UO2•H2O (H/X=525)			
ABSORBERS	None	None			
ENRICHMENT	≤ 5.0 wt%				
REFLECTION	Partial	Partial			

Table 5.3-3: Nuclear Criticality Safety Limits for k_{eff} 0.90, 0.95, and 1.00 for the Safe Geometry Dissolver System Wet Residue Overflow Chute

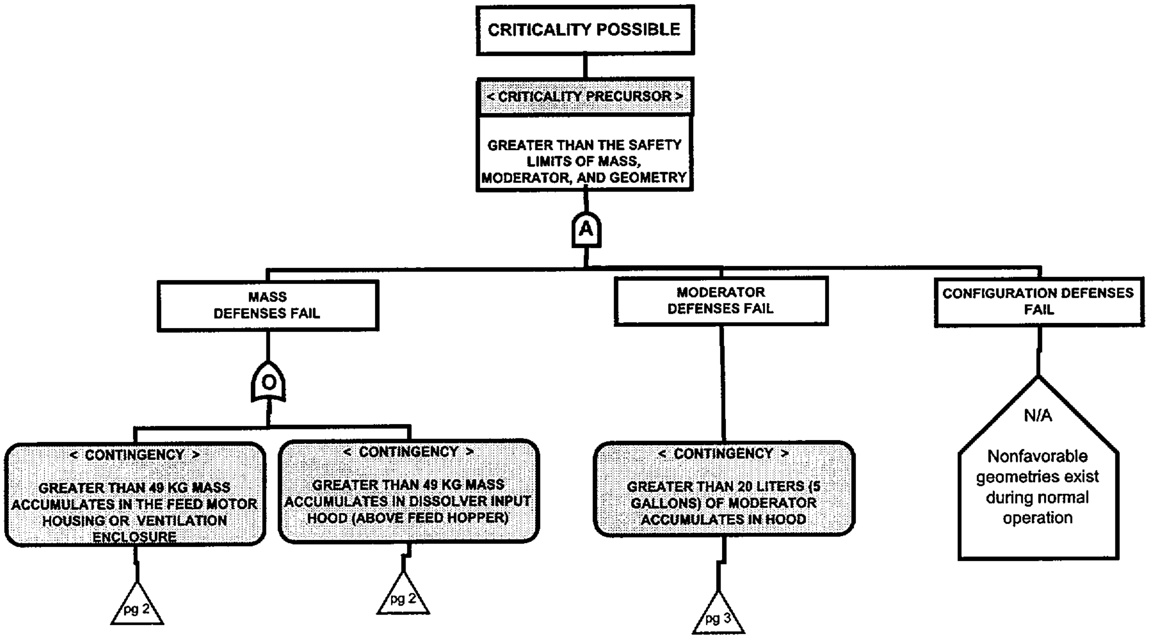
PARAMETER	NORMAL OPERATING CONDITIONS	BOUNDING ASSUMPTION	CRITICALITY SAFETY LIMIT ≤ 0.90	CRITICALITY SAFETY LIMIT ≤ 0.95	CRITICALITY LIMIT ≤ 1.00
^{235}U MASS	Material in Overflow Pack No Material in Chute	Unrestricted UO2	27.6 kg UO2 Minimum Critical Spherical From CRI-94-049	36.6 kg UO2 Minimum Critical Spherical From CRI-94-049	49.2 kg UO2 Minimum Critical Spherical From CRI-94-049
MODERATOR/ CONCENTRATION	Optimum Moderation	Optimum Moderation			
GEOMETRY	Nonfavorable Geometry	Nonfavorable Geometry	11.0 inch Accumulation Derived From CRI-94-049 See RA-NAK-98-039	12.5 inch Accumulation Derived From CRI-94-049 See RA-NAK-98-039	14.5 inch Accumulation Derived From CRI-94-049 See RA-NAK-98-039
SPACING	N/A	N/A			
DENSITY	Homogeneous UO2•H2O	Homogeneous UO2•H2O (H/X=525)			
ABSORBERS	None	None			
ENRICHMENT	≤ 5.0 wt%				
REFLECTION	Partial	Partial			

Table 5.3-4: Nuclear Criticality Safety Limits for k_{eff} 0.90, 0.95, and 1.00 for the Safe Geometry Dissolver System Cylindrical Vessels - For Fixed Spacing and for Individual Cylindrical Vessels With Oxides or Uranyl Nitrate

PARAMETER	SPACING NORMAL CONDITIONS (k-eff = 0.87007)	INDIVIDUAL CYLINDER BOUNDING ASSUMPTION	INDIVIDUAL CYLINDER CRITICALITY SAFETY LIMIT ≤ 0.90	INDIVIDUAL CYLINDER CRITICALITY SAFETY LIMIT ≤ 0.95	INDIVIDUAL CYLINDER CRITICALITY LIMIT ≤ 1.00
^{235}U MASS	Unrestricted	Unrestricted UO2 and uranyl nitrate	Unrestricted UO2 and uranyl nitrate	Unrestricted UO2 and uranyl nitrate	Unrestricted UO2 and uranyl nitrate
MODERATOR/ CONCENTRATION	Optimum	Optimum	Optimum	Optimum	Optimum
GEOMETRY	Favorable Geometry	Favorable	Uranyl Nitrate - 12.47 inches Oxides - 9.6 inches (Diameter)	Uranyl Nitrate - 14.03 inches Oxides - 10.47inches (Diameter)	Uranyl Nitrate - 15.93 inches Oxides - 11.49 inches (Diameter)
SPACING	As per Dwg # 500F03AR03,04	Per Drawing			
DENSITY	Homogeneous UO2•H2O and uranyl nitrate	Homogeneous UO2•H2O (H/X=220) Uranyl Nitrate @ 1000 gU/l			
ABSORBERS	None	None			
ENRICHMENT	≤ 5.0 wt%	≤ 5.0 wt%			
REFLECTION	none	Uranyl Nitrate -Full Oxides- Partial	Uranyl Nitrate -Full Oxides- Partial	Uranyl Nitrate -Full Oxides- Partial	Uranyl Nitrate -Full Oxides- Partial

Calculations for cylinders with uranyl nitrate have been performed for full water reflection and bare cases only. The full water reflection limits are extremely conservative. Limits were taken from CRI-94-051 for oxides and CRI-94-022 for uranyl nitrate. The spacing interaction data are from CRI-94-023.

SAFE GEOMETRY DISSOLVER INPUT HOOD ASSEMBLY
DOUBLE CONTINGENCY PROTECTION



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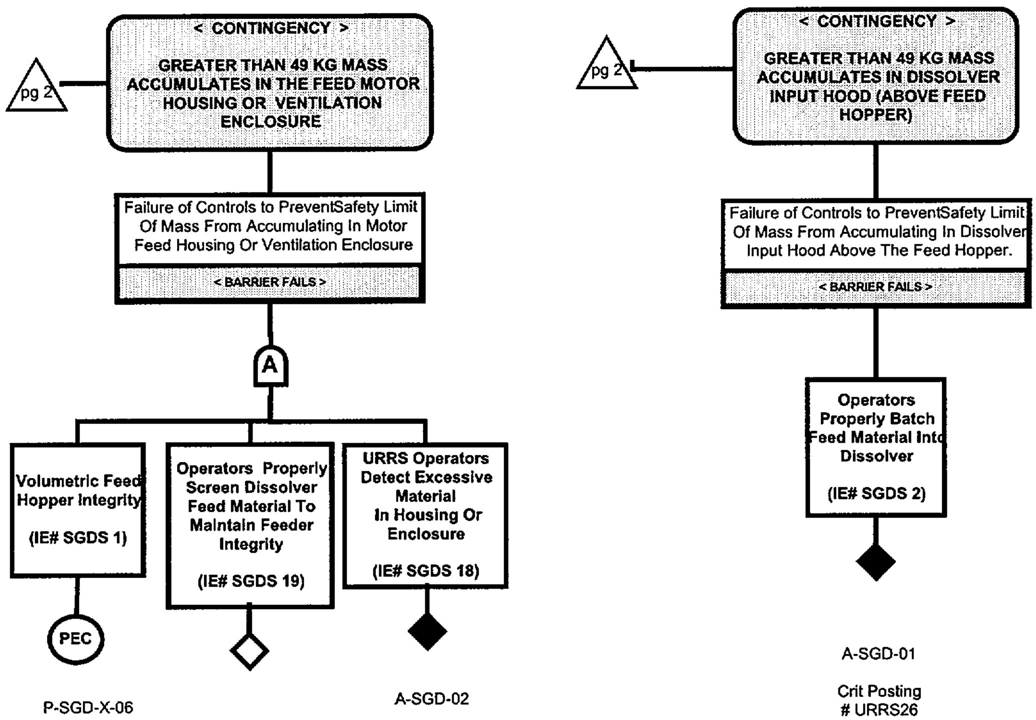
SAFE GEOMETRY DISSOLVER INPUT HOOD ASSEMBLY
DOUBLE CONTINGENCY PROTECTION
MASS DEFENSE



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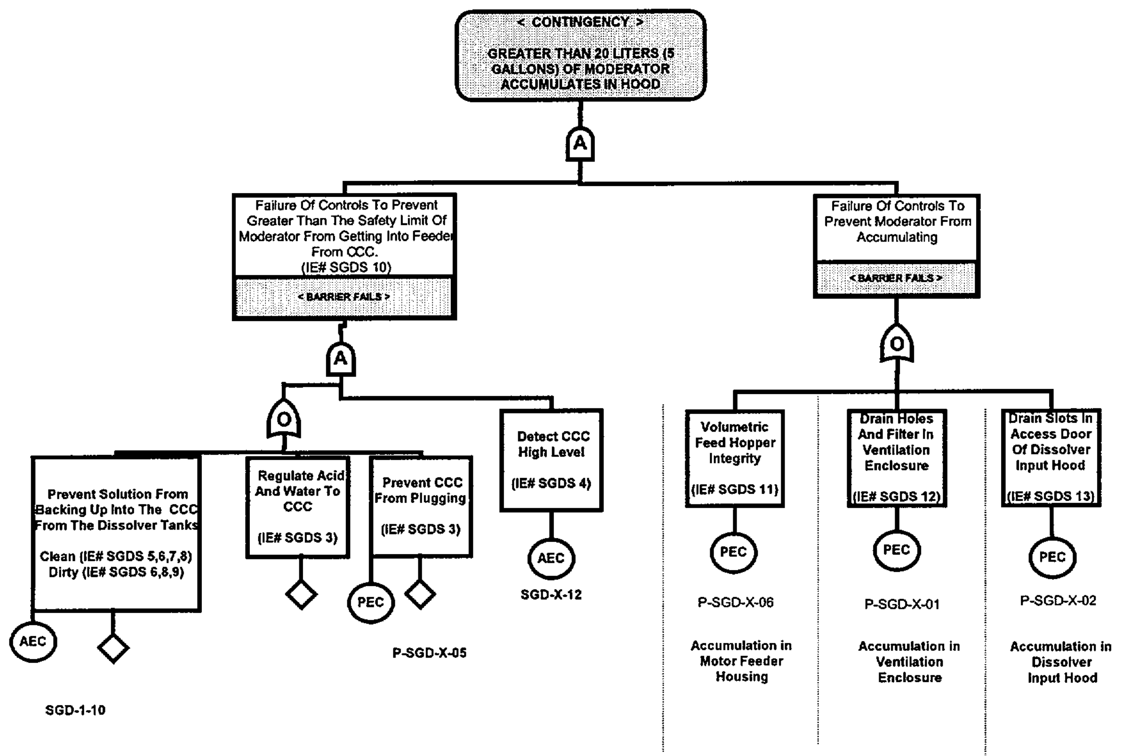
SAFE GEOMETRY DISSOLVER INPUT HOOD ASSEMBLY
DOUBLE CONTINGENCY PROTECTION
MODERATOR DEFENSE



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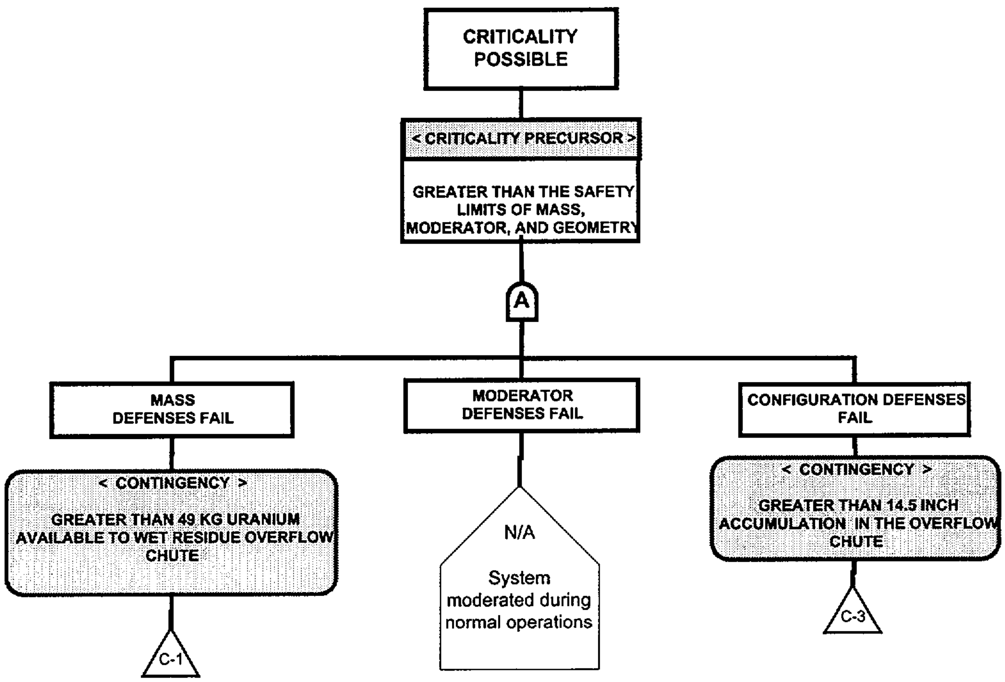
SAFE GEOMETRY DISSOLVER WET RESIDUE OVERFLOW CHUTE DOUBLE CONTINGENCY PROTECTION



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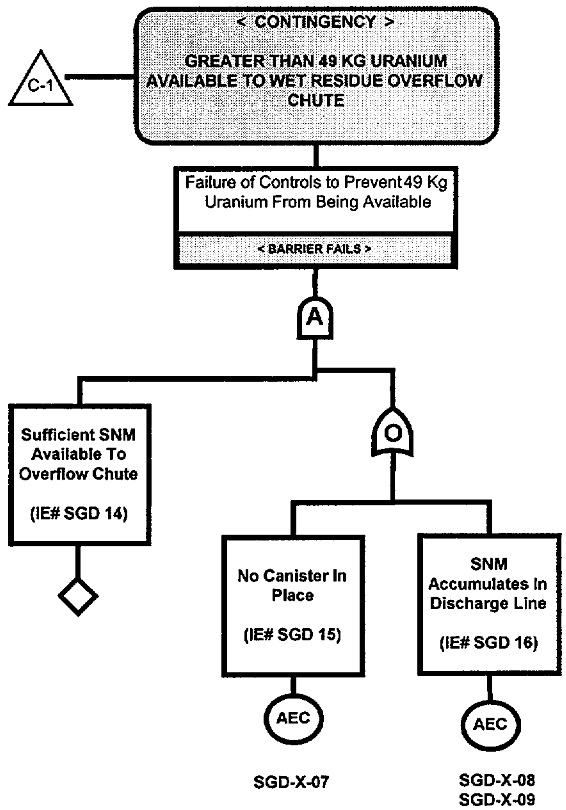
SAFE GEOMETRY DISSOLVER WET RESIDUE OVERFLOW CHUTE
MASS CONTINGENCY



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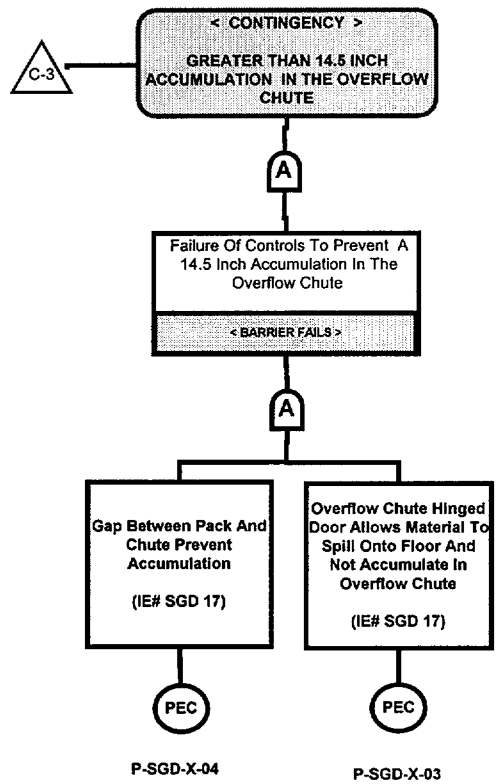
SAFE GEOMETRY DISSOLVER WET RESIDUE OVERFLOW CHUTE GEOMETRY CONTINGENCY



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Fire Safety and Chemical Safety Controls

The fire hazard potential of these dissolvers is low due to the non-combustible materials of construction (stainless steel) and to the fact that no combustible material is used in the dissolvers. Area housekeeping minimizes combustible materials.

The chemical hazard potential of these systems is moderate. Most generated vapors are contained inside the ventilated system which are sent to a scrubber and then to a HEPA filter before being exhausted to the environment. Small leaks and spills are handled by area operators who are trained and equipped with the proper PPE and respiratory protection.

TABLE 2

FIRE HAZARDS POTENTIAL

ACCIDENT SEQUENCE	FIRE POTENTIAL	CONTROL
1. Pipe Break	None	N/A
2. CCC Vessel Fails	None	N/A
3. Electric Motor Shorts Out	Motor Destroyed	Circuit Breaker
4. High Temp. In The CCC	None	Temperature Monitors
5. Cutting & Welding	Tank & Pipe Damage	Cutting Welding Permit System SYP-207 & SYP-305
6. Pump Explosion	None	UN Is Not Combustible Or Flammable
7. Exothermic Reaction Of UN With Basic Or Organic Material	None	No Basic Material In Contact With Dissolver Or Tanks & Organics Removed At SOLX

TABLE 3

CHEMICAL HAZARDS POTENTIAL

ACCIDENT SEQUENCE	CHEMICAL POTENTIAL	CONTROL
1. Pipe Break	None	N/A
2. CCC Vessel Fails	None	N/A
3. Electric Motor Shorts Out	Motor Destroyed	Circuit Breaker
4. High Temp. In The CCC	None	Temperature Monitors
5. Cutting & Welding	Tank & Pipe Damage	Cutting Welding Permit System SYP-207 & SYP-305
6. Pump Explosion	None	UN Is Not Combustible Or Flammable
7. Exothermic Reaction Of UN With Basic Or Organic Material	None	No Basic Material In Contact With Dissolver Or Tanks & Organics Removed At SOLX