

ATTACHMENT 2

-- Non-proprietary Information --

**"ISA Consequence Assessment for Airborne Releases"
Attachment C, "Material at Risk/UF₆ Release Source Terms"
(Non-proprietary Version)**



FRAMATOME ANP

Calculation Number: 32-2400503-00

Title: ISA Consequence Assessments for Airborne Releases

Attachment C: Material at Risk/UF₆ Release Source Terms

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Revision 0

Attachment C

Material at Risk/UF₆ Release Source Terms

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1. Purpose

This Attachment calculates the UF₆ release at different locations of the proposed facility. The areas of interest include the UF₆ Handling Areas, the Cascade Halls, the Blending & Liquid Sampling Area, and the Centrifuge Test Facility. The UF₆ release is calculated in grams.

2. Method

The rate of UF₆ release from difference sources (Feed, Purification, Product, Uranium Byproduct Cylinders, and Cold Traps) were obtained from Reference 1. The release rate calculation is based on area of (20mm x 20mm) 400 mm². Since cold trap (feed and product) area is based on 40mm by 40mm, an adjustment to the release calculation has been performed for Cold Trap by multiplying the release by $(40/20) * (40/20)^{3/2}$ per Eq. 21 of Reference 5.

3. Design Inputs

The design input for calculating the UF₆ release include the geometry, and number of modules, and assays that exist in the proposed facility. There are 3 modules and 2 assays per module in the facility (Reference 3). The design input assumes that per assay there are 5 cylinders in the Feed area, one cylinder for Purification, 3 cylinders for Product, 7 cylinders for Uranium Byproduct Cylinders, one cylinder Cold trap in Feed and one cylinder for Cold Trap in the Product area.

The rate of UF₆ release from various cylinders in different areas is obtained from Reference 1. The volume and the amount of UF₆ present in the piping area are obtained from Reference 2.

4. Assumptions

The major assumptions for calculating the UF₆ release are:

1. The UF₆ release for Feed is calculated at 500 mbar (p. 10 of Reference 12). Reference 1 provides the rate of release at this pressure.
2. The UF₆ release for Purification is calculated at -25 °C (p. 44 of Reference 13). Reference 1 provides the rate of release this temperature.
3. The UF₆ release for Product is calculated at -25 °C (Reference 9). Reference 1 provides the rate of release at this temperature.
4. The UF₆ release for Uranium Byproduct Cylinders is calculated at -25 °C (Reference 11). Reference 1 provides the rate of release at this temperature.
5. The UF₆ release for Receiver is calculated at -25 °C (p. 44 of Reference 13) Reference 1 provides the rate of release at this temperature.
6. The UF₆ release for Cold Trap (Feed & Product) is calculated at - 60 °C and 20 °C (Reference 10). Reference 1 provides the rate of release at this temperature.
7. It is assumed that the UF₆ inventory in the piping and cascades empties in 30 minutes following the event.
8. It is assumed that the outdoor ambient temperature is 100 °F (37.8 °C).
9. It is assumed that the indoor ambient temperature is 77 °F (25 °C).
10. It is assumed that the outdoor wind speed is 0.6 m/sec. (See footnote 12 of Attachment A).
11. It is assumed that the indoor CRDB ambient temperature is 95 °F (35 °C).

5. Computer Use

There is no major computer program for the calculation in this Attachment.

6. Results

The UF₆ release was obtained for different areas of the facility in the event of a hypothetical accident. The locations include UF₆ Handling Areas 1&2 and 3&4/5&6 (lumped together), Cascade Halls 1&2 and 3&4/5&6 (lumped together), Blending & Liquid Sampling Area, and Centrifuge Test Facility.

UF₆ Handling Area Releases

The UF₆ Handling Areas contain Feed, Purification, Product, Uranium Byproduct Cylinders, and cold trap for Feed and Product. Additionally, UF₆ is present in the piping for Feed, Product, and Uranium Byproduct areas.

The section calculates the total release of UF₆ in 30 minutes time period. It is assumed that all the inventories in the piping area will be emptied in 30 minutes time period.

From Appendix 1 of Reference 2 the UF₆ hold up in piping volumes for the UF₆ Handling Areas (per assay) are:

Feed:	UF ₆ (gram)
Feed System	1594.5
Feed Control	61.4
Feed Station	745
Feed Purification	300.0
Vent Pipes	101.6
Hot Box	22

Product:	UF ₆ (gram)
Product System	69.7
Valves (1)	50.3
Valves (2)	640.4
Product Station	40.7
Product Vent	14
Exit Product Vent	6

Uranium Byproducts:	UF ₆ (gram)
Cylinders System	16
Valves (1)	401.7
Valves (2)	2663.2
Tail Station (1)	123.9
Tail Station (2)	9.9
Vent Pipe Work	22.8

The source of UF₆ release rate in the UF₆ Handling Areas is Reference 1.

In order to calculate the UF₆ (gram) in the Feed area:

The rate of release is 0.72 gram/second per cylinder per assay.

$$\begin{aligned}\text{UF}_6 \text{ release} &= (0.72 \text{ gram/sec}) * (30\text{min} * 60 \text{ sec/min}) * (5 \text{ cylinder per assay}) * (6 \text{ assay}) \\ &= 38880 \text{ grams of UF}_6\end{aligned}$$

For Cold Trap Feed the UF₆ (gram) is:

The rate of release is 0.065 gram/second per cylinder per assay.

The adjustment for area for Cold Trap release is (since the area is 40x40mm instead of 20x20mm) $(40/20) (40/20)^{3/2} = 5.6568$ (Eq. 21 of Reference 5)

$$\begin{aligned}\text{UF}_6 \text{ release} &= (0.065 \text{ gram/sec}) * (30\text{min} * 60 \text{ sec/min}) * (1 \text{ cylinder/assay}) * (6 \text{ assay}) * 5.6568 \\ &= 3971.1 \text{ grams of UF}_6\end{aligned}$$

This process is repeated for Purification, Product, Uranium Byproduct Cylinders, and Cold Traps to obtain the UF₆ release from the assays. The amount of the release is added to the inventory in the pipe being released in the event of a hypothetical accident.


The releases were obtained for 30 minutes, 2.5 minutes and 0.17 minutes (10 seconds) time period.

**SEISMIC UF₆
RELEASE
UF₆ Handling Area
PUBLIC - UNCONTROLLED**

Time (min) 30 Release Duration
Assays (#) 6

40 x 40 mm hole size instead of 20x20 mm, W=H=40 mm for Cold Trap

SOURCE of UF ₆	g/sec	# cylinders per assay		grams	Comment:
Feed @ 500 mbar	0.72	5	# cylinders per assay	38880	Ref. 1
Purification @ -25C	0.002	1	# cylinders per assay	21.6	Ref. 1
Product @ -25C	0.002	3	# cylinders per assay	64.8	Ref. 1
Cylinders @ -25C	0.002	7	# cylinders per assay	151.2	Ref. 1
Cold Trap Feed @20C	0.065	1	# cylinders per assay	3971.1	Ref. 1(adj. area by W(H ³ /2)
Cold Trap Product @ 20C	0.065	1	# cylinders per assay	3971.1	Ref. 1(adj. area by W(H ³ /2)
		TOTAL (g) (30min)	Pouring from Cylinders	47060	

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Therefore, the total UF₆ release from all the UF₆ Handling Areas is 88,358 grams. The area of UF₆ Handling Area 1&2 is one third of the total UF₆ Handling Areas.

Therefore, the material at risk (MR) for 30 minutes is:

MR for UF ₆ Handling Area 1&2	= (1/3) * 88,358	= 29,453 grams of UF ₆
MR for UF ₆ Handling Area 3&4/5&6	= (2/3) * 88,358	= 58,905 grams of UF ₆

**Worker Elsewhere in the Room:
For 2.5 minutes:**

**SEISMIC UF₆
RELEASE
UF₆ Handling Area
WORKER -**

UNCONTROLLED	2.5 min	
Time (min)	2.5	Release Duration
Assays (#)	6	

40 x 40 mm hole size instead of 20x20 mm, W=H=40 mm for Cold Trap

SOURCE of UF ₆	g/sec	# cylinders per assay	grams	
Feed @ 500 mbar	0.72	5	# cylinders per assay	3240 Ref. 1
Purification @ -25C	0.002	1	# cylinders per assay	1.8 Ref. 1
Product @ -25C	0.002	3	# cylinders per assay	5.4 Ref. 1
Cylinders @ -25C	0.002	7	# cylinders per assay	13 Ref. 1
				Ref. 1(adj. area by W(H ³ /2))
Cold Trap Feed @20C	0.065	1	# cylinders per assay	331
				Ref. 1(adj. area by W(H ³ /2))
Cold Trap Product @ 20C	0.065	1	# cylinders per assay	331
		TOTAL (g) (2.5 min)	Pouring from Cylinders	3922



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Pipes (empty in 30 minutes)

Grams

1594.5

feed:

Ref. 2

per assay

61.4

745

300

101.6

22

feed =

2824.5

69.7

product:

50.3

640.4

40.7

14

6

product=

821.1

16

Cylinders:

401.7

2663.2

123.9

9.9

22.8

Cylinders=

3237.5

Total in 30
minutesmultiply by 6 for entire
plant

41299

Total in 2.5
minutes

(ratio by 2.5/30)

3441

TOTAL Cylinders and Pipes(3922+3441)=

7363

Grams
of UF₆Prepared by: Farrokh SeifaeiReviewed by: Barbara Hubbard

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Therefore, the total UF₆ release from all the UF₆ Handling Areas is 7,363 grams. The area of UF₆ Handling Area 1&2 is one third of the total UF₆ Handling Areas.

Therefore, the material at risk (MR) for 2.5 minutes is:

MR for UF ₆ Handling area 1&2	= (1/3) * 7,363	= 2,454 grams of UF ₆
MR for UF ₆ Handling area 3&4/5&6	= (2/3) * 7,363	= 4,909 grams of UF ₆

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Cascade Hall Releases

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Blending & Liquid Sampling Area Releases

The Blending & Liquid Sampling Area contains UF₆ in donor, receivers, and cold traps. Additionally, UF₆ is present in the piping in the Blending & Liquid Sampling Area. There is only one area of Blending & Liquid Sampling Area.

The section calculates the total release of UF₆ in 30 minutes time period. It is assumed that all the inventories in the piping area will be emptied in 30 minutes time period.

From Reference 2 the UF₆ hold up in piping volumes for Blending & Liquid Sampling Area is:

B&S:	UF ₆ (gram)
Solid Donor Station	229.1
Transfer Pipes (1)	943.3
Transfer Pipes (2)	970.2
Transfer Pipes (3)	845.4
Vent System	39.5
Vent Pipe Receiver	13.1
Cold Trap	4.1

**SEISMIC UF₆
RELEASE
Blending & Liquid
Sampling
PUBLIC - UNCONTROLLED**

Time (min) 30 Release Duration


40 x 40 mm hole size instead of 20x20 mm, W=H=40 mm for Cold Trap

SOURCE of UF ₆	g/sec Ref.1	# cylinders per assay		grams	
Donor @ 53C	0.72	2	# cylinders per 3 modules	2592	Ref. 1
Receiver @ -25C	0.002	4	# cylinders per 3 modules	14.4	Ref. 1
Cold trap Donor @ 20C	0.065	1	# cylinders per 3 modules	662	Ref. 1 (adj. area by W(H ³ /2))
		TOTAL (g) (30min)	Pouring from Cylinders	3268	
Pipes (empty in 30 minutes) grams					
229.1		Ref. 2			
943.3					
970.2					
845.4					
39.5					
13.1					
4.1					
43.8	b&s =	3089			
		Total from pipes		3089	
		TOTAL Cylinders and Pipes(3268+3089)=		6357	grams

As seen, the total UF₆ release from the Blending & Liquid Sampling Area is 6,357 grams.

Therefore, the material at risk (MR) for 30 minutes is:

MR for Blending & Liquid Sampling Area = 6,357 grams of UF₆

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Worker Elsewhere in the Room:
For 2.5 minutes:

SEISMIC UF₆
RELEASE
Blending & Liquid
Sampling
WORKER -

UNCONTROLLED 2.5 min
Time (min) 2.5 Release Duration
Assays (#) 6

40 x 40 mm hole size instead of 20x20 mm, W=H=40 mm for Cold Trap

SOURCE of UF ₆	g/sec Ref. 1	# cylinders per assay	grams	adj. area by W(H ^{3/2})
Donor @ 53C	0.72	2	216	
Receiver @ -25C	0.002	4	1.2	
Cold trap Donor @ 20C	0.065	1	55	
TOTAL (g) (2.5 min)		Pouring from Cylinders		272



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Pipes (empty in 30 minutes)

Grams

Ref. 2

229.1

943.3

970.2

845.4

39.5

13.1

4.1

43.8


b&s = 3089

Total from pipes 3089

Total in 2.5 minutes (ratio by 2.5/30 min) 258

TOTAL Cylinders and Pipes (272+258)= 530 gPrepared by: Farrokh SeifaeReviewed by: Barbara Hubbard

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As seen, the total UF₆ release from the Blending & Liquid Sampling Area is 530 grams.

Therefore, the material at risk (MR) for 2.5 minutes is:

MR for Blending & Liquid Sampling Area = 530 grams of UF₆

Centrifuge Test Facility Releases

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Cascade Hall Releases (Manifold Connections Only)

The following release calculation evaluated the UF₆ release from the Cascade Halls for 30 minutes time duration. The UF₆ that contain in the manifold connections (Feed, Product, and Uranium Byproduct Cylinders to one Assay) is calculated below (FF9). The remaining 2 assays are calculated in FF11-2.


FIRE UF₆ RELEASE

Centrifuge FF9	All three UF ₆ manifold connections (feed, product, and Uranium Byproduct Cylinders)		
1594.5	feed:	Ref. 2	per assay
61.4			
745			
300			
101.6			
22	feed total=		2824.5
69.7	product:		
50.3			
640.4			
40.7			
14			
6	product=		821.1
16	Cylinders:		
401.7			
2663.2			
123.9			
9.9			
22.8	Cylinders=		3237.5
Total (g)			6883.1

FF11-2 All six UF₆ manifold connections (feed, product, and Uranium Byproduct Cylinders)

The UF₆ release for this case is twice the FF9 since it is 6 manifolds instead of 3

$$\text{Total (g)} = 2 * 6883.1 = 13766.2 \text{ g}$$

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Single Cylinder Releases

The Single Cylinder Releases are calculated for various areas. The total release of UF₆ includes 30 minutes, 2.5 minutes, and 10 seconds time period.

Single Cylinder Releases (See Note 1)

Run in Building with HVAC on for Controlled Case

Exposure Duration (min)	Release Duration (min)	Receptor	Uncontrolled /IROFS	Temperature (°C)	Pressure (mbar)	Release Rate (g/sec)	Release Volume (grams)	Case
Single Feed Cylinder Release in the UF ₆ Feed Area						Ref. 1		SCR-1
30	30	Public	Uncontrolled		500	0.72	1296	
2.5	2.5	Worker	Uncontrolled		500	0.72	108	
0.17	0.17	Local W.	Uncontrolled		500	0.72	7.2	
Single Product or Tail Cylinder Release in the UF ₆ Feed Area								SCR-2
30	30	Public	Uncontrolled	-25		0.002	3.6	
2.5	2.5	Worker	Uncontrolled	-25		0.002	0.3	
0.17	0.17	Local W.	Uncontrolled	-25		0.002	0.02	
Single Product Cold Trap or Feed Cold Trap in the UF ₆ Feed Area								SCR-3
40mm vs. 20mm used in pouring. Scale up using Eq. 21 from Ref. 5								
Pouring is proportional to ratio of $W(H^{3/2})$, $W=H=40$ mm								
30	30	Public	Uncontrolled	-60		0.0001	1.02	
2.5	2.5	Worker	Uncontrolled	-60		0.0001	0.08	
0.17	0.17	Local W.	Uncontrolled	-60		0.0001	0.01	

Single Feed or Product Cold Trap in the UF₆ Feed Area in De-Gas Mode
40mm vs. 20mm used in pouring. Scale up using Eq. 21 from Ref. 5
Pouring is proportional to ratio of $W(H^{3/2})$, $W=H=40$ mm

SCR-4

30	30	Public	Uncontrolled	20	0.065	662
2.5	2.5	Worker	Uncontrolled	20	0.065	55
0.17	0.17	Local W.	Uncontrolled	20	0.065	4

Single Uranium Byproduct Cylinders at 100 °F=37.8 °C

SCR-5

30	30	Public	Uncontrolled	37.8	0.43	774
2.5	2.5	Worker	Uncontrolled	37.8	0.43	64.5
0.17	0.17	Local W.	Uncontrolled	37.8	0.43	4.3

Single Uranium Byproduct Cylinders at 86 °F=30 °C

SCR-5_a

30	30	Public	Uncontrolled	30	0.234	421.2
2.5	2.5	Worker	Uncontrolled	30	0.234	35.1
0.17	0.17	Local W.	Uncontrolled	30	0.234	2.34

Single Uranium Byproduct Cylinder at 77 °F=25 °C

SCR-6

30	30	Public	Uncontrolled	25	0.144	259.2
2.5	2.5	Worker	Uncontrolled	25	0.144	21.6
0.17	0.17	Local W.	Uncontrolled	25	0.144	1.4

Pouring Cylinder at 86 °F=30 °C, 10 mm² (Reference 1) instead of 400 mm²

SCR-6_a

Pouring is proportional to ratio of $W(H^{3/2})$, and adj. for the area $\sqrt{400}=20\text{mm}$ to $\sqrt{10}=3.16\text{mm}$, $W=H=3.16\text{ mm}$

30	30	Public	Uncontrolled	30	0.234	4.18
2.5	2.5	Worker	Uncontrolled	30	0.234	0.35
0.17	0.17	Local W.	Uncontrolled	30	0.234	0.02

Pouring Cylinder at 77 °F=25 °C, 4.2 mm² (Reference 1) instead of 400 mm²

SCR-6_b

Pouring is proportional to ratio of $W(H^{3/2})$, and adjusting for the area $\sqrt{400}=20\text{ mm}$ to $\sqrt{4.2}=2.05\text{mm}$

30	30	Public	Uncontrolled	25	0.144	0.87
2.5	2.5	Worker	Uncontrolled	25	0.144	0.07
0.17	0.17	Local W.	Uncontrolled	25	0.144	0.005

Single Product (Donor) in the Blending & Liquid Sampling Area

SCR-7

30	30	Public	Uncontrolled	500	0.72	1296
2.5	2.5	Worker	Uncontrolled	500	0.72	108
0.17	0.17	Local W.	Uncontrolled	500	0.72	7.2

Single Product (Receiver) in the Blending & Liquid Sampling Area

SCR-8

30	30	Public	Uncontrolled	-25	0.002	3.6
2.5	2.5	Worker	Uncontrolled	-25	0.002	0.3
0.17	0.17	Local W.	Uncontrolled	-25	0.002	0.02

Single Donor Cold Trap in the Blending & Liquid Sampling Area at -60 °C
40mm vs. 20mm used in pouring. Scale up using Eq. 21 from Reference 5
Pouring is proportional to ratio of $W(H^{3/2})$, $W=H=40$ mm

SCR-9

30	30	Public	Uncontrolled	-60	0.0001	1.02
2.5	2.5	Worker	Uncontrolled	-60	0.0001	0.08
0.17	0.17	Local W.	Uncontrolled	-60	0.0001	0.01

Single Donor Cold Trap in the Blending & Liquid Sampling Area in De-Gas Mode at 20 °C
40mm vs. 20mm used in pouring. Scale up using Eq. 21 from Reference 5
Pouring is proportional to ratio of $W(H^{3/2})$, $W=H=40$ mm

SCR-10

30	30	Public	Uncontrolled	20	0.065	662
2.5	2.5	Worker	Uncontrolled	20	0.065	55
0.17	0.17	Local W.	Uncontrolled	20	0.065	4

Single Cylinder in the Ventilated room (TSB) for maintenance at -50 C
40mm (Reference 7) vs 20mm used. Scale up using Eq. 21 from Reference 5,
release is proportional to ratio of $W(H^{3/2})$, $W=H=40$ mm

TSB-VR-4

30	30	Public	Uncontrolled	-50	p. 14 of	0.0001	1.0
2.5	2.5	Worker	Uncontrolled	-50	Ref. 6	0.0001	0.1
0.17	0.17	Local W.	Uncontrolled	-50		0.001	0.01

Single cylinder in the Blending & Liquid Sampling Area at 77 F=25 °C
3/8 inch (10mm) (p. 41 of Ref. 8 1S cylinder) vs 20mm used. Scale up using Eq. 21 from Ref. 5
release is proportional to ratio of $W(H^{3/2})$, $W=H=10$ mm

BS-1

30	30	Public	Uncontrolled	25		0.144	45.8
2.5	2.5	Worker	Uncontrolled	25		0.144	3.8
0.17	0.17	Local W.	Uncontrolled	25		0.144	0.3

Single Cylinder in Receipt & Dispatch Building at 95 F=35 C
8.5 in (216mm) by 1 in (25.4mm), (p. 55 of Ref. 8 48Y cylinder) vs 20mm by 20mm. Scale up using Eq. 21 from Reference 5
 $1 \times 4.25 = 4.25$ Sq in, Equal Length for square, $D=(4.25)^{0.5} = 2.062$ in=52.36mm
adjust area for 52.36 mm instead of 20mm using Eq 21 from Reference 5
Release is proportional to ratio of $W(H^{3/2})$, $W=H=52.36$ mm

CRDB-1

30	30	Public	Uncontrolled	35		0.36	7186
2.5	2.5	Worker	Uncontrolled	35		0.36	599
0.17	0.17	Local W.	Uncontrolled	35		0.36	40

Note (1): Ambient Pressure Effect On Release Rate

The release rates used in the present Attachment were based on Eq. 21 of Reference 5. The ambient pressure used in Eq. 21 of Reference 1 was 101.35 KPa (14.7 psia). Per Reference 14, The site elevation is in the order of 3420 ft. The elevation corresponds to about 13 psia or 89.62 KPa by interpolating the elevation versus pressure of Table E.4 in Reference 15.

As a result, a sensitivity study was performed based the ambient pressure of 89.63 KPa.

The release rate in Eq. 21 of Reference 5 is repeated here. For the entire definitions of the terms please refer to Reference 5.

$$M_{UF6} = \frac{2 (MW_{UF6} P_{UF6}) [(2g (p_v - p_a) / p_v)^{0.5} W H^{1.5}]}{3 R T K}$$

Where K is defined as:

$$K = \{ 1 + [(P_{atm} - P_{UF6})/P_{atm}]^{2/3} (p_a / p_v)^{1/3} \}^{3/2}$$

In the above equation P_{atm} is the ambient pressure, P_{UF6} is partial pressure of UF₆ at Temperature T, and p_a and p_v are densities of air and UF₆, respectively. Since P_{atm} is only used in K term, only the sensitivity effect of P_{atm} on K was performed. Two cases of P_{atm} =101.35 KPa (K1) and P_{atm} = 89.63 KPa (K2) were compared. The density of air and UF₆ were kept constant. The partial pressure of UF₆ was varied. It was assumed that temperature remains constant at 100 °F.

$$p_a = 1.136 \text{ Kg/m}^3 \text{ (Table E.3 of Ref. 15)} \quad p_v = 3300 \text{ Kg/m}^3 \text{ (Ref. 5)}$$

PUF6	p _v	p _a	Patm=101.35KPa	K1	Patm=89.63KPa	K2	%change of K1 & K2
0	3300	1.136	1.01E+05	1.10724	8.96E+04	1.10724	0.00
5000	3300	1.136	1.01E+05	1.10361	8.96E+04	1.10315	0.04
10000	3300	1.136	1.01E+05	1.09993	8.96E+04	1.09898	0.09
15000	3300	1.136	1.01E+05	1.09618	8.96E+04	1.09474	0.13
20000	3300	1.136	1.01E+05	1.09237	8.96E+04	1.09040	0.18
25000	3300	1.136	1.01E+05	1.08847	8.96E+04	1.08596	0.23
30000	3300	1.136	1.01E+05	1.08450	8.96E+04	1.08141	0.29
35000	3300	1.136	1.01E+05	1.08044	8.96E+04	1.07674	0.34
40000	3300	1.136	1.01E+05	1.07628	8.96E+04	1.07194	0.40
45000	3300	1.136	1.01E+05	1.07201	8.96E+04	1.06697	0.47
50000	3300	1.136	1.01E+05	1.06761	8.96E+04	1.06182	0.54

As seen, the percentage difference of K1 and K2 is very small and negligible. Therefore, the effect of ambient pressure on UF₆ release rate is insignificant.

7. Conclusion

The material at risk (UF₆ release) following a hypothetical accident is calculated at various locations in the proposed facility. A summary of these releases is tabulated in the table below.

These values will be used for U and HF exposures to the public and workers in the proposed plant.

Summary of UF₆ Releases

Release point	Material at Risk Duration 30 min UF ₆ (gram)	Material at Risk Duration 2.5 min UF ₆ (gram)	Material at Risk Duration 0.17 min UF ₆ (gram)
UF ₆ Handling Area 1&2	29,453	2,454	N/A
UF ₆ Handling Area 3&4/5&6	58,905	4,909	N/A
Cascade Halls 1&2	[]*	[]*	N/A
Cascade Halls 3&4/5&6	[]*	[]*	N/A
Blending & Liquid Sampling Area	6,357	530	N/A
Centrifuge Test Facility	[]*	[]*	[]*

Cascade Hall Release (manifold connections)


FF9	6883.1 gram
FF11-2	13766.2 gram

** Trade Secret*

The Single Cylinder Releases are:

Summary of UF₆ (gram) Single Cylinder Releases

Case	30 minutes	2.5 minutes	0.17 minute
SCR-1	1296	108	7.2
SCR-2	3.6	0.3	0.02
SCR-3	1.02	0.08	0.01
SCR-4	662	55	4
SCR-5	774	64.5	4.3
SCR-5-a	421.2	35.1	2.34
SCR-6	259.2	21.6	1.4
SCR-6_a	4.18	0.35	0.02
SCR-6_b	0.87	0.07	0.005
SCR-7	1296	108	7.2
SCR-8	3.6	0.3	0.02
SCR-9	1.02	0.08	0.01
SCR-10	662	55	4
TSB-VR-4	1.0	0.1	0.01
BS-1	45.8	3.8	0.3
CRDB-1	7186	599	40

 FRAMATOME ANP	Calculation Number: <u>32-2400503-00</u> Title: <u>ISA Consequence Assessments for Airborne Releases</u> Attachment C: <u>Material at Risk/UF₆ Release Source Terms</u>	Page C32 of 32 Revision 0
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