

TGT-CALC-103-011

Project/System	Hall A Tritium Target
Number	PS-TGT-14-001
Author	Dave Meekins
Date	8/31/2015
Applicable Codes and Standards	JLAB Site FSAD
References:	
<ul style="list-style-type: none"> • Pan and Rigdon, Tritium Oxidation in Atmospheric Transport • JLAB Emergency Management Technical Basis 	
Description:	
<p>This calculation uses Hot Spot to predict the maximum expected dose to workers and public. Two scenarios are discussed</p> <ul style="list-style-type: none"> • Full release of tritium target in acute 10 min interval at the top of the Hall A truck ramp • Full release of tritium target in acute 10 min interval through the stack. <p>Assumptions include:</p> <ul style="list-style-type: none"> • Target load of 1100 Ci of T2 • Release is immediately converted to HT(90%)+HTO(10%) • Topography is “city” • Weather is class F • DCF is FGR-13 • Inversion layer is enabled at 500m • Resuspension is allowed (velocity is 0.05 cm/s) 	

1 Truck Ramp Release

The conditions assume for the release at the top of the truck ramp are:

- Target load of 1100 Ci of T2
- Release is immediately converted to HT(90%)+HTO(10%)
 - This should be very conservative based on work given in references.
- Stability class "F" calm (conservative) and city.
- Wind speed at 10m height is 1 m/s
- Stack height 2m (average for truck ramp exit and HT will be released at the top of the ramp)
- Stack diam is 5m
- FGR-13 Dose conversion factor
- 1 day exposure time

1.1 Hot Spot results

The results are summarized in the Hot Spot output file below:

```
HotSpot Version 3.0.2 Tritium Release
Sep 01, 2015 11:19 AM

Source Material      : Tritium
Material-at-Risk (MAR) : 1.1000E+03 Ci 10 % Tritium Oxide
Damage Ratio (DR)   : 1.00
Airborne Fraction (ARF) : 1.000
Respirable Fraction (RF) : 1.000
Leakpath Factor (LPF) : 1.000
Respirable Source Term : 1.10E+03 Ci
Non-respirable Source Term : 0.00E+00 Ci
Physical Stack Height : 2.0 m
Stack Exit Velocity : 0.00 m/s
Stack Diameter : 5.0 m
Stack Effluent Temp. : 0.0 deg C
Air Temperature : 0.0 deg C
Effective Release Height : 2.00 m
Wind Speed (h=10 m) : 1.00 m/s
Wind Direction : 340.0 degrees Wind from the NNW
Wind Speed (h=H-eff) : 0.38 m/s
Stability Class (City) : F
Respirable Dep. Vel. : 0.05 cm/s
Non-respirable Dep. Vel. : 8.00 cm/s
Receptor Height : 1.5 m
Inversion Layer Height : 500 m
Sample Time : 10.000 min
Breathing Rate : 3.33E-04 m3/sec
Distance Coordinates : All distances are on the Plume Centerline
```

Maximum Dose Distance : 0.010 km
 MAXIMUM TED : 1.5 rem
 Inner Contour Dose : 0.100 rem
 Middle Contour Dose : 0.080 rem
 Outer Contour Dose : 0.010 rem
 Exceeds Inner Dose Out To : 0.056 km
 Exceeds Middle Dose Out To : 0.064 km
 Exceeds Outer Dose Out To : 0.20 km

FGR-13 Dose Conversion Data - Total Effective Dose (TED)

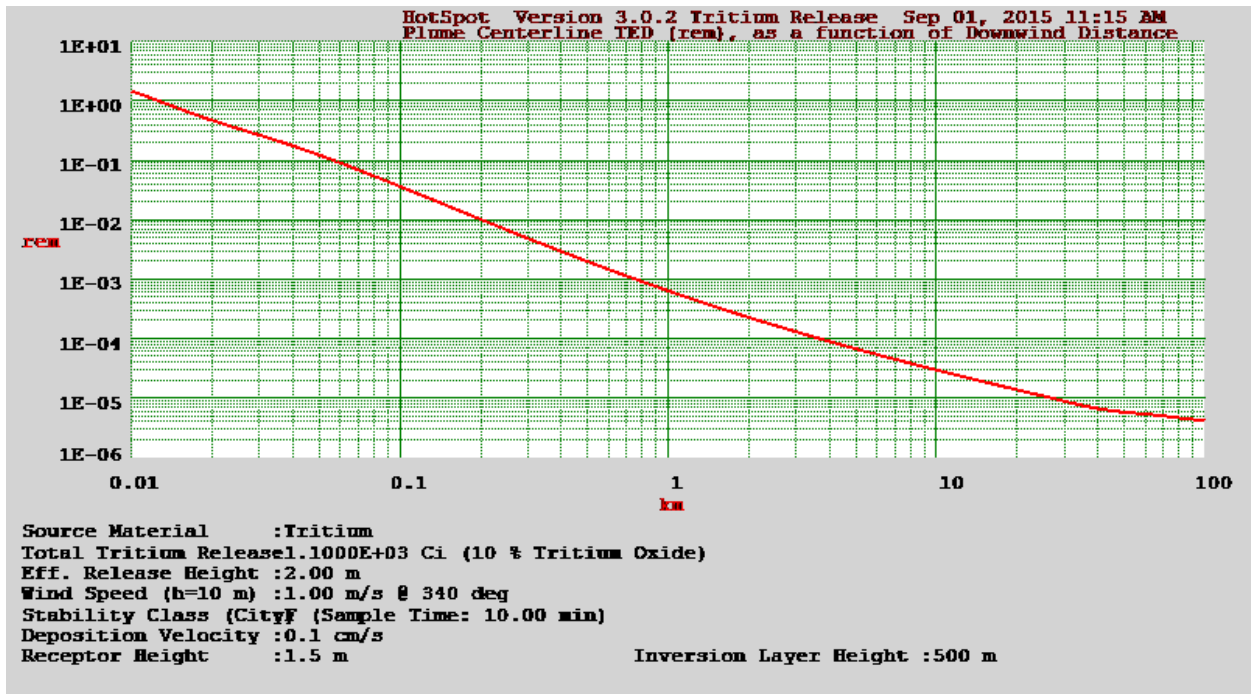
Note: Dose Results Include HTO Skin Absorption

Include Plume Passage Inhalation and Submersion
 Include Resuspension (Resuspension Factor : Constant Value) 1.00E-05 1/meter
 Exposure Window:(Start: 0.00 days; Duration: 1.00 days) [100% stay time].

RESPIRABLE				
DISTANCE	T E D	TIME-INTEGRATED	GROUND SURFACE	ARRIVAL
km	(rem)	AIR CONCENTRATION	DEPOSITION	TIME
km	(rem)	(Ci-sec)/m3	(uCi/m2)	(hour:min)
0.010	1.5E+00	4.3E+02	2.2E+04	<00:01
0.100	3.6E-02	1.1E+01	5.4E+03	00:04
0.200	1.0E-02	3.0E+00	1.5E+03	00:08
0.300	4.8E-03	1.4E+00	7.2E+02	00:13
0.400	2.9E-03	8.6E-01	4.3E+02	00:17
0.500	2.0E-03	5.8E-01	2.9E+02	00:21
0.600	1.5E-03	4.3E-01	2.1E+02	00:26
0.700	1.1E-03	3.3E-01	1.7E+02	00:30
0.800	9.1E-04	2.7E-01	1.3E+02	00:35
0.900	7.5E-04	2.2E-01	1.1E+02	00:39
1.000	6.3E-04	1.9E-01	9.4E+01	00:43
2.000	2.3E-04	6.7E-02	3.3E+01	01:27
4.000	8.9E-05	2.6E-02	1.3E+01	02:55
6.000	5.4E-05	1.6E-02	7.9E+00	04:22
8.000	3.8E-05	1.1E-02	5.6E+00	05:50
10.000	2.9E-05	8.7E-03	4.3E+00	07:17
20.000	1.4E-05	4.0E-03	2.0E+00	14:35
40.000	6.6E-06	1.9E-03	9.7E-01	>24:00
60.000	5.4E-06	1.6E-03	7.9E-01	>24:00
80.000	4.6E-06	1.4E-03	6.8E-01	>24:00

1.2 Total effective Dose

The following plot shows the total effective dose from this release condition:



1.3 Map Overlay

A map overlay from Google Earth:



1.4 Case Summary

The model indicates that even for this worst case scenario with extremely conservative assumptions regarding the amount of HTO converted at release time that the maximum offsite dose to a member of the public is about 10 mrem (the EPA limit for routine exposure to the MEI). The dose to a worker positioned at the top of the ramp is expected to be about 1 rem (for 1 days of exposure time).

2 Stack Release

The second case considers a full release through the exhaust stack. The stack is assumed to be 20 m higher than the site boundary and positioned at the Northeast smoke removal blower on the Hall dome. The conditions assume for the release through the stack are:

- Target load of 1100 Ci of T2
- Release is immediately converted to HT(90%)+HTO(10%)
 - This should be very conservative based on work given in references.
- Stability class "F" calm (conservative) and city.
- Wind speed at 10m height is 1 m/s
- Stack height 20m (average for truck ramp exit and HT will be released at the top of the ramp)
- Stack diam is 0.5 m
- FGR-13 Dose conversion factor
- 1 day exposure time

2.1 Hot Spot results

The results are summarized in the Hot Spot output file below:

```
HotSpot Version 3.0.2 Tritium Release
Sep 01, 2015 11:32 AM

Source Material      : Tritium
Material-at-Risk (MAR) : 1.1000E+03 Ci 10 % Tritium Oxide
Damage Ratio (DR)   : 1.00
Airborne Fraction (ARF) : 1.000
Respirable Fraction (RF) : 1.000
Leakpath Factor (LPF) : 1.000
Respirable Source Term : 1.10E+03 Ci
Non-respirable Source Term : 0.00E+00 Ci
Physical Stack Height : 20.0 m
Stack Exit Velocity : 0.00 m/s
Stack Diameter : 0.5 m
Stack Effluent Temp. : 0.0 deg C
Air Temperature : 0.0 deg C
Effective Release Height : 20 m
Wind Speed (h=10 m) : 1.00 m/s
Wind Direction : 340.0 degrees Wind from the NNW
Wind Speed (h=H-eff) : 1.52 m/s
Stability Class (City) : F
Respirable Dep. Vel. : 0.05 cm/s
Non-respirable Dep. Vel. : 8.00 cm/s
Receptor Height : 1.5 m
Inversion Layer Height : 500 m
Sample Time : 10.000 min
```

Breathing Rate : 3.33E-04 m3/sec
 Distance Coordinates : All distances are on the Plume Centerline

Maximum Dose Distance : 0.19 km
 MAXIMUM TED : 9.61E-04 rem
 Inner Contour Dose : 0.100 rem
 Middle Contour Dose : 0.080 rem
 Outer Contour Dose : 0.010 rem
 Exceeds Inner Dose Out To : Not Exceeded
 Exceeds Middle Dose Out To : Not Exceeded
 Exceeds Outer Dose Out To : Not Exceeded

FGR-13 Dose Conversion Data - Total Effective Dose (TED)

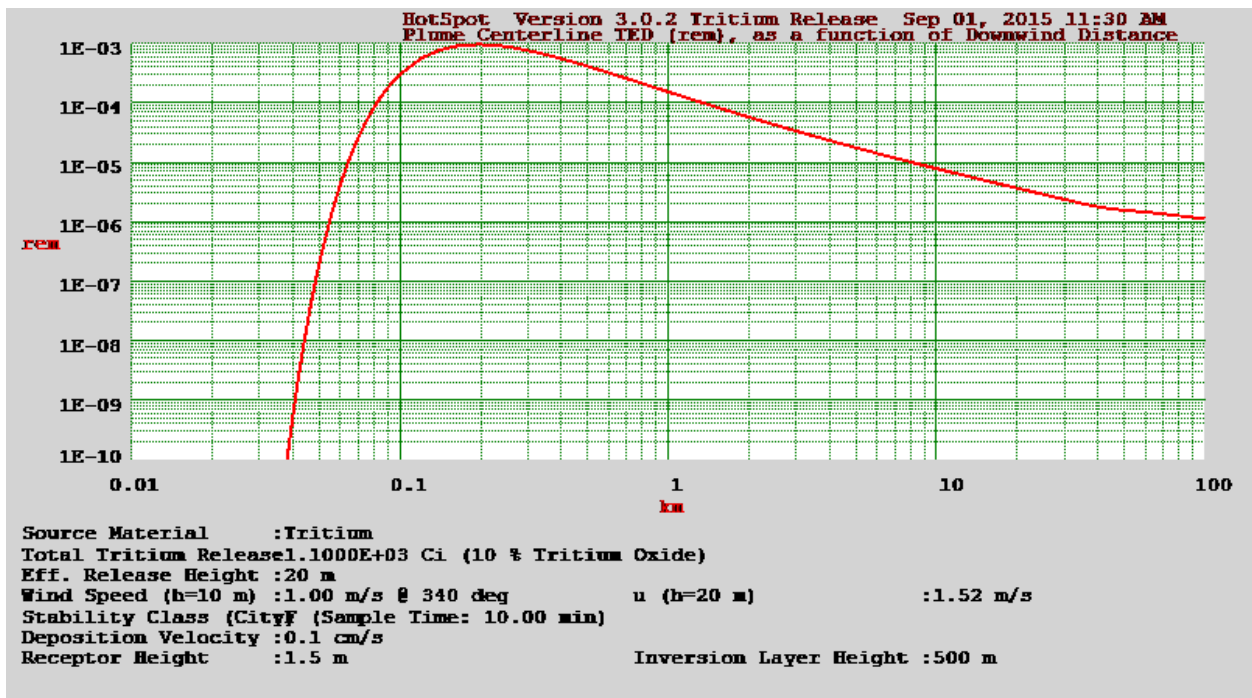
Note: Dose Results Include HTO Skin Absorption

Include Plume Passage Inhalation and Submersion
 Include Resuspension (Resuspension Factor : Constant Value) 1.00E-05 1/meter
 Exposure Window:(Start: 0.00 days; Duration: 1.00 days) [100% stay time].

RESPIRABLE				
DISTANCE	T E D	TIME-INTEGRATED	GROUND SURFACE	ARRIVAL
km	(rem)	AIR CONCENTRATION (Ci-sec)/m3	DEPOSITION (uCi/m2)	TIME (hour:min)
0.030	1.7E-15	4.9E-13	2.6E-12	<00:01
0.100	3.0E-04	8.9E-02	3.9E+01	00:01
0.200	9.6E-04	2.8E-01	1.4E+02	00:02
0.300	7.6E-04	2.2E-01	1.1E+02	00:03
0.400	5.5E-04	1.6E-01	8.2E+01	00:04
0.500	4.1E-04	1.2E-01	6.1E+01	00:05
0.600	3.2E-04	9.5E-02	4.7E+01	00:06
0.700	2.6E-04	7.6E-02	3.8E+01	00:07
0.800	2.1E-04	6.3E-02	3.1E+01	00:08
0.900	1.8E-04	5.3E-02	2.6E+01	00:09
1.000	1.5E-04	4.5E-02	2.3E+01	00:11
2.000	5.7E-05	1.7E-02	8.5E+00	00:22
4.000	2.3E-05	6.8E-03	3.4E+00	00:43
6.000	1.4E-05	4.2E-03	2.1E+00	01:05
8.000	1.0E-05	3.0E-03	1.5E+00	01:27
10.000	7.8E-06	2.3E-03	1.2E+00	01:49
20.000	3.7E-06	1.1E-03	5.4E-01	03:39
40.000	1.8E-06	5.2E-04	2.6E-01	07:19
60.000	1.5E-06	4.3E-04	2.2E-01	10:59
80.000	1.3E-06	3.7E-04	1.9E-01	14:39

2.2 Total effective dose

The following plot shows the total effective dose from this release condition:



2.3 Map Overlay

A map overlay from Google Earth:



2.4 Case Summary

The model indicates that even for this worst case scenario with extremely conservative assumptions regarding the amount of HTO converted at release time that the JLAB MEI of 10 mrem at 300m is not exceeded. The dose to anyone positioned on the ground is expected to be less than 1 mrem (for 4 days of exposure time).