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Quantitative Risk Assessment and Institute of Makers of Explosives Safety Analysis for Risk (IMESAFR) – Variance Requests

U.S. Department of Justice
Bureau of Alcohol, Tobacco, Firearms and Explosives

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IMESAFR

- Probabilistic risk assessment software tool used to calculate risk to individuals from explosives facilities
- Developed to provide a more comprehensive assessment of overall risk from explosives storage (long-term and temporary) as well as risk from a variety of other explosives operations (e.g. manufacturing, disposal, demil, assembly, inspection)
- Not intended or developed to evaluate risk from fireworks or pyrotechnic operations
- Includes ATF's tables of distances for high explosives and blasting agents

IMESAFR

- Calculates risk in terms of the statistical expectation for loss of life from an explosives event.

- Probability of fatality P(f) is determined from:
  - The probability of an explosives event;
  - The probability of a fatality given an event;
  - The average exposure of an individual.

- Individual and group risk are calculated for:
  - Workers directly involved with explosives activity
  - People associated with the explosives operations but not directly involved with the activity.
  - Individuals in the general public (unrelated).

IMESAFR – Common Terms

- Potential Explosion Site (PES): A location that contains a quantity of explosives that creates a blast, fragment, thermal, or debris hazard (e.g. Explosives storage magazines).
- Exposed Site (ES): A location exposed to the hazardous effects from an explosion at a PES (e.g. inhabited buildings and highways).
- Individual Risk: Sum of all significant risks to an individual in an ES from all PESs. Also known as Probability of Fatality P(f).
- Group Risk: Sum of all individual risks in a group. Also known as Expected Annual Fatalities E(f).
- IBD – Inhabited Building Distance

Basic Variance Requirements – 555.22

- Good cause
- Within the purpose of the regulation
- Consistent with the effect intended by regulation
- Substantially equivalent to the prescribed regulation
- Cannot be contrary to any provision of law
- Will not result in an increase in cost to the government
- Will not hinder the effective administration of the explosives regulations

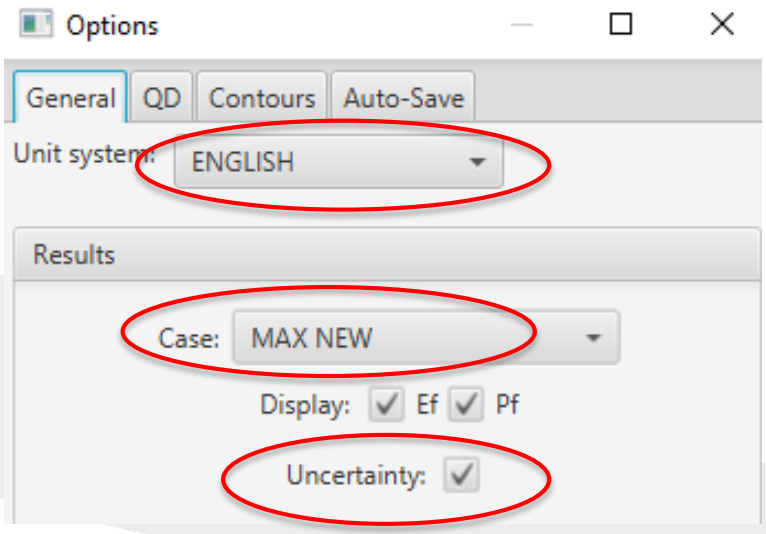
Requests should include the following:

- Licensee or permittee name
- License or permit number
- Point of contact (for follow-up questions)
- Address of storage location
- Justification for the variance (i.e. good cause)
- Additional policies/practices that are in place that exceed regulatory requirements, and help reduce risk at the storage site

Please include the following:

- IMESAFR File – Using the most recent software version
- Photo of the site (if used in IMESAFR file)
- Site Plan
- Distances

IMESAFR General Settings:



Potential Explosion Site (PES) Information

- Photos of the magazines
- Desired net explosives weight for each magazine
- Magazine description worksheets

Explosives Storage Magazine Description Worksheet
(Submit one for each magazine; you may photocopy for additional magazines)

For ATF Use Only

Global Positioning System (GPS) Coordinates

Applicant name:

Magazine ID no:

State/local explosives magazine certificate number, if any:

Storage magazine address:

A. Type of magazine *(e.g., permanent, mobile/portable, indoor/outdoor, building, igloo, tunnel, dugout, box, trailer, semitrailer, or other mobile magazine)*:

ATF Type: *(Check one)* ☐ I ☐ II ☐ III ☐ IV ☐ V

B. Location of magazine and distance from licensed place of business and other magazine:

C. Distance to nearest storage magazine, regardless of ownership:

D. Describe terrain features, roads, structures, buildings, utilities, etc., that could be damaged if the contents of the magazine exploded:

E. Distance(s) between the magazine and the feature(s):

Indicate if magazine is: ☐ Barricaded ☐ Unbarricaded

Show distance in feet to: Closest highway: Closest inhabited bldg:

Closest passenger railway:

F. Materials, including thicknesses, used in construction of magazine:

Roof: Top: Walls: Bottom:

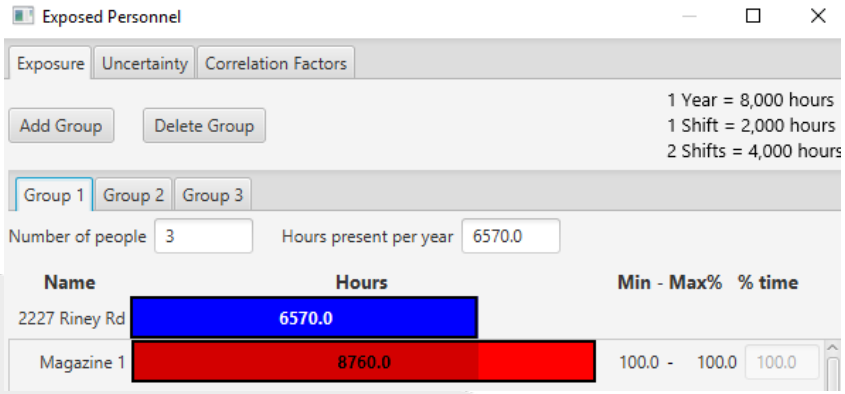
Doors: Floor:

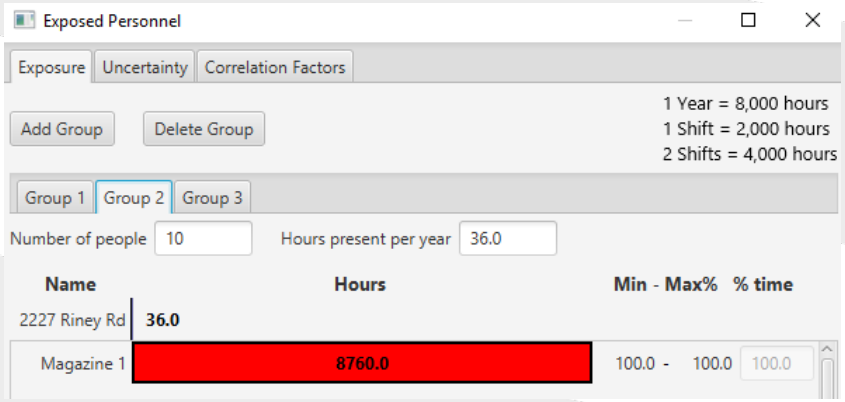
Exposed Site (ES) – Inhabited buildings

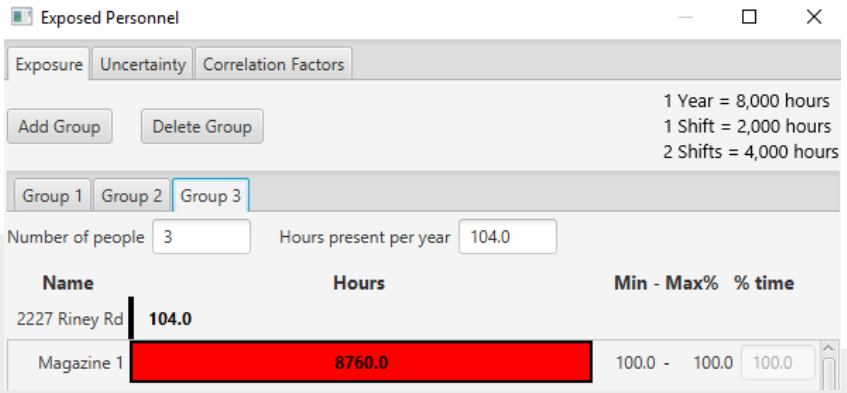
ES – Inhabited building

Population estimates, July 1, 2019, (V2019)	141,541	328,239,523
Two or More Races, percent	3.2%	2.8%
Hispanic or Latino, percent (b)	23.9%	18.5%
White alone, not Hispanic or Latino, percent	59.9%	60.1%
Population Characteristics		
Veterans, 2014-2018	6,108	18,611,432
Foreign born persons, percent, 2014-2018	12.5%	13.5%
Housing		
Housing units, July 1, 2019, (V2019)	X	139,684,244
Owner-occupied housing unit rate, 2014-2018	48.0%	63.8%
Median value of owner-occupied housing units, 2014-2018	$196,900	$204,900
Median selected monthly owner costs -with a mortgage, 2014-2018	$1,653	$1,558
Median selected monthly owner costs -without a mortgage, 2014-2018	$696	$490
Median gross rent, 2014-2018	$1,046	$1,023
Building permits, 2019	X	1,386,048
Families & Living Arrangements		
Households, 2014-2018	46,561	119,730,128
Persons per household, 2014-2018	2.65	2.63
Living in same house 1 year ago, percent of persons age 1 year+, 2014-2018	73.1%	85.5%
Language other than English spoken at home, percent of persons age 5 years+, 2014-2018	22.8%	21.5%

ES – Inhabited building





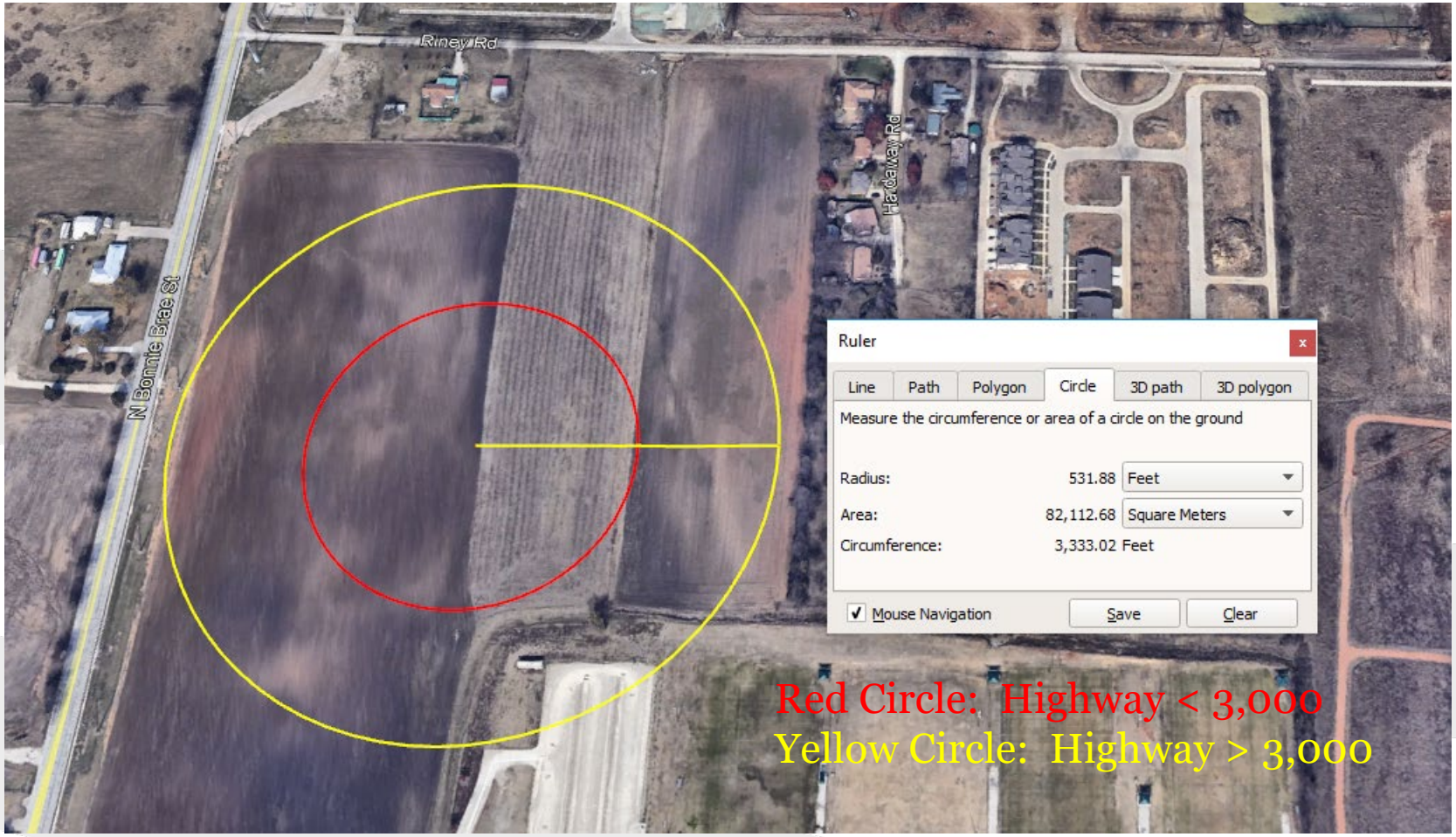


ES – Inhabited building

2227 Riney Rd

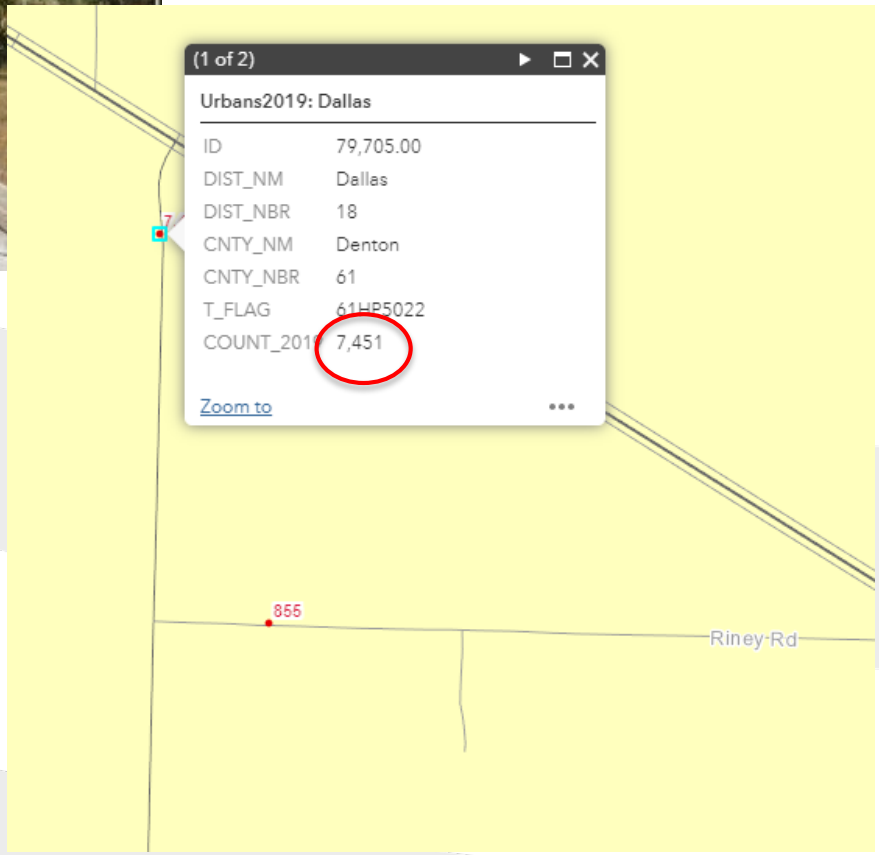
3315 N. Bonnie Brae St

ES – Highways

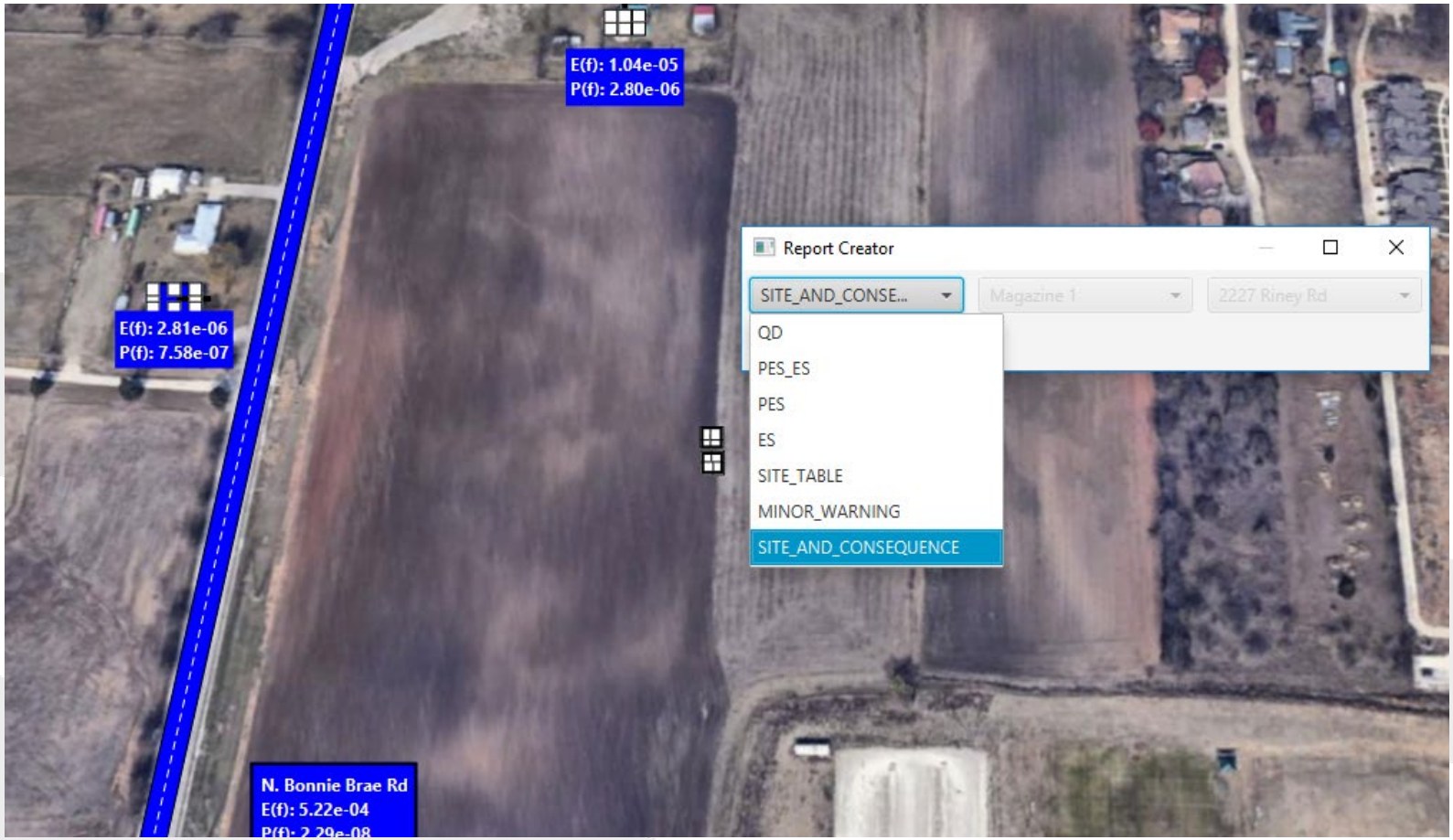

Riney Rd
N Bonnie Brae St
Hardaway Rd
Ruler
Line
Path
Polygon
Circle
3D path
3D polygon
Measure the circumference or area of a circle on the ground
Radius: 531.88 Feet
Area: 82,112.68 Square Meters
Circumference: 3,333.02 Feet
Mouse Navigation
Save
Clear
Red Circle: Highway < 3,000
Yellow Circle: Highway > 3,000

ES – Highways

N. Bonnie Brae St



Group Risk (E_f) – Site & Consequence Report



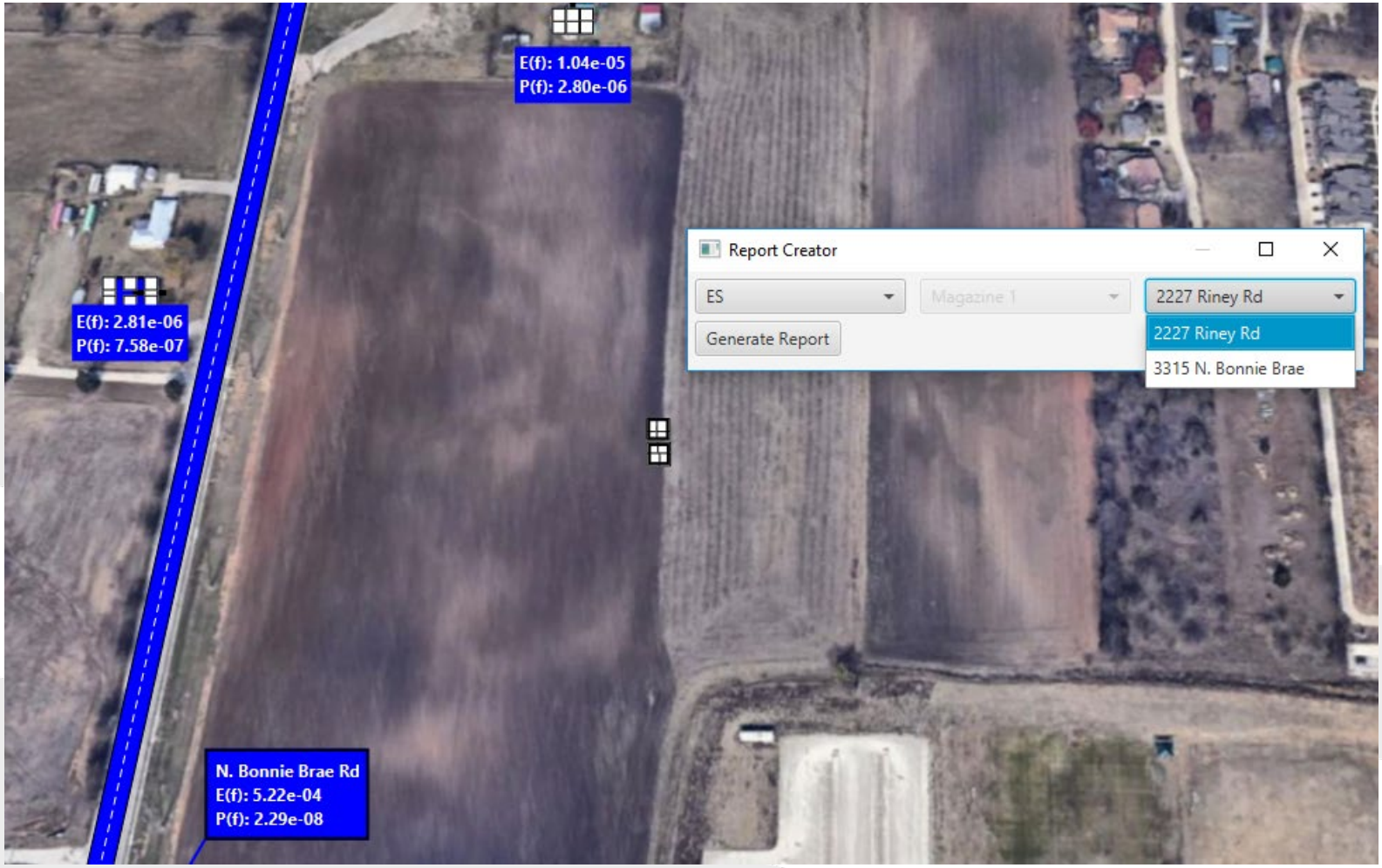
Group Risk (E_f) – Site & Consequence Report

IMESAFR v (2.1.15)
Scenario: Virtual Meeting
Report Type: Site And Consequence Report
User: Michael O'Lena
Certification #: APT-06212018-06

Individual Risk Results			
Maximum NEWQD		**Expected NEWQD**	
P_f Related Criterion:	1.00E-04		
Maximum P_f Related:	0.00E+00	Maximum P_f Related:	0.00E+00
Maximum P_{maji} Related:	0.00E+00	Maximum P_{maji} Related:	0.00E+00
Maximum P_{mini} Related:	0.00E+00	Maximum P_{mini} Related:	0.00E+00
P_f Public Criterion:	1.00E-06		
Maximum P_f Public:	2.80E-06 (2227 Riney Rd)	Maximum P_f Public:	2.53E-06 (2227 Riney Rd)
Maximum P_{maji} Public:	5.82E-06 (N. Bonnie Brae Rd)	Maximum P_{maji} Public:	5.82E-06 (N. Bonnie Brae Rd)
Maximum P_{mini} Public:	5.00E-06 (N. Bonnie Brae Rd)	Maximum P_{mini} Public:	5.00E-06 (N. Bonnie Brae Rd)

Group Risk Results			
Maximum NEWQD		**Expected NEWQD**	
E_f Related Criterion:	1.00E-03		
E_f Related:	0.00E+00	E_f Related:	0.00E+00
E_{maji} Related:	0.00E+00	E_{maji} Related:	0.00E+00
E_{mini} Related:	0.00E+00	E_{mini} Related:	0.00E+00
E_f Public Criterion:	1.00E-05		
E_f Public:	5.35E-04	E_f Public;	5.34E-04
E_{maji} Public:	1.83E-04	E_{maji} Public:	1.83E-04
E_{mini} Public:	1.55E-04	E_{mini} Public:	1.54E-04

Individual Risk (P_f) – ES Report



Individual Risk (P_f) – ES Report

IMESAFR v (2.1.15)
Scenario: Virtual Meeting
Report Type: ES Report - Fatality
User: Michael O'Lena
Certification #: APT-06212018-06

ES: 2227 Riney Rd

Results case: **Max** NEW/ **Max** Yield

This ES is not affected by a functionally related PES

Risk Results - Unrelated PES

PES	Distance (ft)	E_f	P_f individual	Base P_e	Adjusted P_e
Magazine 1	649	1.00E-05	2.70E-06	2.80E-05	2.99E-05
Magazine 2	687	3.55E-07	9.59E-08	2.80E-05	2.99E-05
Combined Results		1.04E-05	2.80E-06		

Consequence Results - Unrelated PES

PES	$P_{f\|e}$ Overall	$P_{f\|e}$ Overpressure	$P_{f\|e}$ Glass	$P_{f\|e}$ BC	$P_{f\|e}$ Hor. Debris	$P_{f\|e}$ Vert. Debris	$P_{f\|e}$ Thermal
Magazine 1	3.61E-02	2.07E-09	1.00E-10	1.16E-10	3.50E-02	1.10E-03	0.00E+00
Magazine 2	1.28E-03	2.07E-09	1.00E-10	1.16E-10	1.21E-03	7.16E-05	0.00E+00

Individual Risk (P_f) – ES Report

IMESAFR v (2.1.15)
Scenario: Virtual Meeting
Report Type: ES Report - Fatality
User: Michael O'Lena
Certification #: APT-06212018-06

ES: 3315 N. Bonnie Brae

Results case: **Max** NEW/ **Max** Yield

This ES is not affected by a functionally related PES

Risk Results - Unrelated PES

PES	Distance (ft)	E_f	P_f individual	Base P_e	Adjusted P_e
Magazine 1	850	2.77E-06	7.49E-07	2.80E-05	2.99E-05
Magazine 2	861	3.20E-08	8.64E-09	2.80E-05	2.99E-05
Combined Results		2.81E-06	7.58E-07		

Consequence Results - Unrelated PES

PES	$P_{f\|e}$ Overall	$P_{f\|e}$ Overpressure	$P_{f\|e}$ Glass	$P_{f\|e}$ BC	$P_{f\|e}$ Hor. Debris	$P_{f\|e}$ Vert. Debris	$P_{f\|e}$ Thermal
Magazine 1	9.99E-03	2.07E-09	1.00E-10	1.76E-10	9.28E-03	7.18E-04	0.00E+00
Magazine 2	1.15E-04	2.07E-09	1.00E-10	1.76E-10	8.49E-05	3.03E-05	0.00E+00

Individual Risk (P_f) – Highways

Review Process

- To help facilitate processing the request, industry members should submit the following:

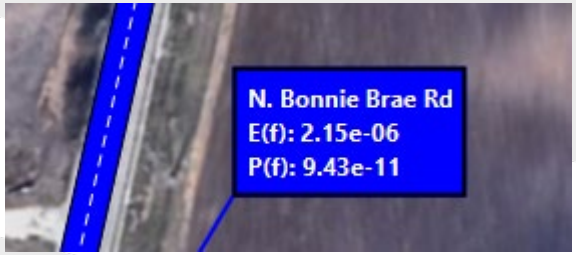
    1. Individual risk for each ES (1 ES report for each inhabited building)
    2. Group risk (Site & Consequence report)
    3. Good cause
    4. Additional policies/procedures that help reduce risk

- EIPB will verify all information submitted with the request

- This may involve onsite verification by EIPB and/or the local area office

Review Process

Group Risk Results	
Maximum NEWQD	
E_f Related Criterion:	1.00E-03
E_f Related:	0.00E+00
E_{maji} Related:	0.00E+00
E_{mini} Related:	0.00E+00
E_f Public Criterion:	1.00E-05
E_f Public:	3.47E-06
E_{maji} Public:	1.65E-06
E_{mini} Public:	3.88E-06



ES: 2227 Riney Rd

Results case: **Max** NEW/ **Max** Yield

This ES is not affected by a functionally related PES

Risk Results - Unrelated PES

PES	Distance (ft)	E_f	P_f individual	Base P_e	Adjusted P_e
Magazine 1	649	7.50E-07	2.03E-07	2.80E-05	2.99E-05
Magazine 2	687	1.64E-07	4.44E-08	2.80E-05	2.99E-05
Combined Results		9.14E-07	2.47E-07		

ES: 3315 N. Bonnie Brae

Results case: **Max** NEW/ **Max** Yield

This ES is not affected by a functionally related PES

Risk Results - Unrelated PES

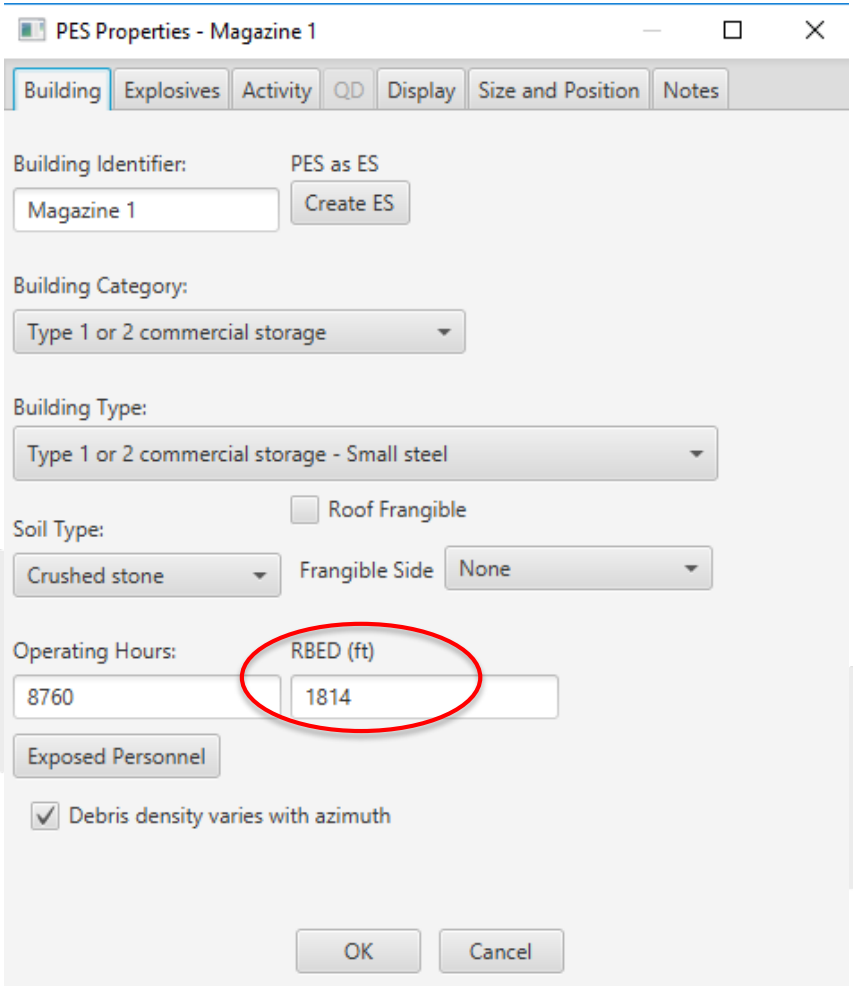
PES	Distance (ft)	E_f	P_f individual	Base P_e	Adjusted P_e
Magazine 1	850	3.83E-07	1.03E-07	2.80E-05	2.99E-05
Magazine 2	861	2.48E-08	6.71E-09	2.80E-05	2.99E-05
Combined Results		4.08E-07	1.10E-07		

Risk Bank Requests

- Compares the risk from 3 scenarios
- **Scenario A**: Desired NEW at current location that does not meet TOD.
- **Scenario B**: Legitimate storage option that meets TOD but is not desired.
- **Scenario C**: Desired NEW at desired location that does not meet TOD but introduces a change to the site that reduces risk to a level equal to or lower than the other scenarios.
- The risk in Scenario C must be equal to or lower than the risk in Scenarios A & B.

Other Considerations

- Underground Magazines
- Barricades
- Combining Magazines
- RBED
- Detonator Storage



IMESAFR

- 9 approvals using Risk Bank
- 17 approvals using Numerical Risk Criterion
- 1 denial and 1 withdrawn
- 11 approvals for underground storage
- 3 year variance approvals
    - Based on renewal date
    - Must re-submit request

- Direct all IMESAFR questions to EIPB.
    - EIPB@atf.gov; or
    - 202-648-7120