An Overview of Risk-Based Explosives Safety Siting for The 2018 International Explosives Safety Symposium & Exposition

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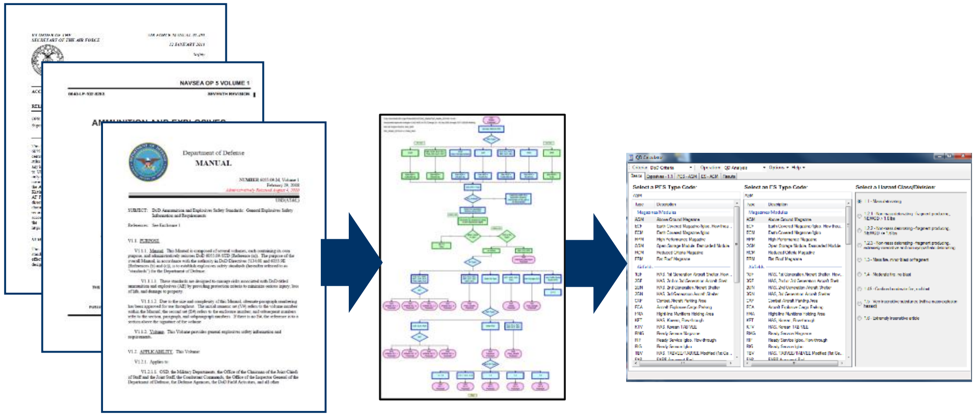
Introduction

- **Problem:**
  - **Explosives storage and handling facilities require site plan approval from Department of Defense (DoD) Explosives Safety Board (DDESB) to operate**
  - **Quantity-Distance (QD) violations can be mitigated through risk acceptance by the component Military Service**
  - **Quantitative information on hazards and consequences is needed by officials who accept risk for explosive facilities not meeting QD criteria.**
- **Solution:**
  - **Make use of Explosives Safety Siting (ESS) software, which is a GIS based automated site planning tool that is used DoD-wide for generation of site plan packages**
  - **Incorporate hazard-consequence analysis tools into ESS:**
    - Tier 1- ASAP-X based on DoD 6055.09M consequences
    - Tier 2a- HAZX based on DDESB TP-14 revision 4 algorithms
    - Tier 2b- DDESB Risk Based Explosives Safety Analysis based on DDESB TP-14 revision 4 algorithms using numerical event probabilities and acceptance criteria (i.e. SAFER)

Overview

- Introduction
- Background
- Technical Approach
- Verification Results
- RBESS Demonstration
- Conclusions and Path Forward

Background- What is ESS?



- DoD sponsored software developed for use by all DoD services.
- Software developed and maintained by NAVFAC EXWC on behalf of the DDESB
- Used for:
  - Automated calculation and display of explosives safety quantity distance (ESQD) arcs
  - Automated and standardized Site Plan Package development
  - Automated and standardized Potential Explosion Site (PES) data

Background- Tier 1 ASAP-X

- **Consequences are based on damage descriptions for hazard zones in 6055.09-M**
- **Simple input consisting of cost and number of occupants**
- **Consequences based on ES location within hazard zone**
- **ESS QD engine used in implementation to calculate hazard zones**

PES NAME:			
DESCRIPTION:			
HAZARD DIVISION	NEW (LBS)	Is the PES an open pad, ECM, or Other?	ECM
1.1	70000		Yes
1.2.1			
1.2.1 MCE		Is the ECM 26 ft x 60 ft or larger and a loading density less than 0.028 lbs/cubic feet?	No
1.2.2			
1.2.3			
1.2.3 MCE		Is the ECM Undefined?	No
1.2.3 HFD (xx)			
1.3			
1.4			

NEW in Pounds Distance in Feet Bldg Cost is a Generic Value

An ES Name must be entered for every ES being evaluated

ES INPUT DATA FOR

ES Name	Dist from PES	Personnel at ES	Bldg Cost	ECM Orientation	On Base
ES_Z1	250	10	100		
ES_Z2	400	10	100		
ES_Z3	500	10	100		
ES_Z4	700	10	100		
ES_Z5	1000	10	100		
ES_Z6	1500	10	100		
ES_Z7	2000	10	100		

GPS Data Input Table

	Degrees	Minutes	Seconds	Direction	Degrees	Minutes	Seconds	Direction
PES								

GPS Data Input Table

ES Information	Degrees	Minutes	Seconds	Direction	Degrees	Minutes	Seconds	Direction
ES_Z1								
ES_Z2								
ES_Z3								
ES_Z4								
ES_Z5								
ES_Z6								
ES_Z7								

EARTH COVERED MAGAZINE ZONE OUTPUT FOR

EARTH COVERED MAGAZINE OUTPUT FOR

ECM FRONT DISTA	ECM REAR DISTAN	ECM SIDE DISTAN	ZONE	FATAL	BUILDING DAMAGE LOSS	INJURIE	% FATAL	% BLDG DAMA	% INJURIES
247	247	247	1 (K6)						
371	371	371	2 (K9)	10	100		100%	100%	
453	453	453	3 (K11)	9	100	1	90%	100%	10%
742	495	659	4 (K18)	10	150	6	50%	75%	30%
989	989	989	5 (PTRD)						
1,649	1,649	1,649	6 (IBD)	1	29	1	5%	15%	5%

TOTAL PEOPLE AFFECTED	60
TOTAL FATALITIES	30
% FATALITIES	50%
TOTAL INJURIES	8
% INJURIES	13%
TOTAL BUILDING COSTS	600
TOTAL BLDG DAMAGE LOSS	$379
% BUILDING DAMAGE LOSS	63%
TOTAL ESs AFFECTED	6

ON BASE DATA FOR

ECM FRONT DISTA	ECM REAR DISTAN	ECM SIDE	ZONE	FATAL	BUILDING DAMAGE	INJURIES	% FATAL	% BLDG	% INJURI
247	247	247	1 (K6)						
371	371	371	2 (K9)	10	100		100%	100%	
453	453	453	3 (K11)	9	100	1	90%	100%	10%
742	495	659	4 (K18)	10	150	6	50%	75%	30%
989	989	989	5 (PTRD)						
1,649	1,649	1,649	6 (IBD)	1	29	1	5%	15%	5%

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% BUILDING DAMAGE LOSS	63%
TOTAL ESs AFFECTED	

OFF BASE DATA FOR

FRONT DISTANCE	ECM REAR DISTANCE	ECM SIDE	ZONE	FATAL	BUILDING DAMAGE	INJURIES	% FATAL	% BLDG	INJURIE
247	247	247	1 (K6)						
371	371	371	2 (K9)						
453	453	453	3 (K11)						
742	495	659	4 (K18)						
989	989	989	5 (PTRD)						
1,649	1,649	1,649	6 (IBD)						

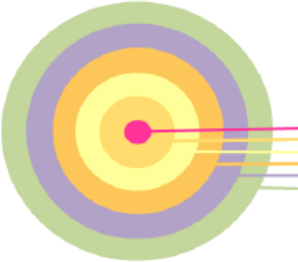
TOTAL PEOPLE AFFECTED	0
TOTAL FATALITIES	
% FATALITIES	
TOTAL INJURIES	
% INJURIES	
TOTAL BUILDING COSTS	0
TOTAL BLDG DAMAGE LOSS	
% BUILDING DAMAGE LOSS	
TOTAL ESs AFFECTED	

ES OUTPUT DATA

ES Name	Distance From PES	On Base	Zone	Personnel at ES	Fatalities	Injuries	Building Cost	Building Damage Loss
ES_Z1	250		2 (K9)	10	10.0	0.0	100	100.0
ES_Z2	400		3 (K11)	10	8.6	1.0	100	100.0
ES_Z3	500		4 (K18)	10	7.0	2.3	100	91.9
ES_Z4	700		4 (K18)	10	2.9	3.7	100	57.3
ES_Z5	1000		6 (IBD)	10	0.2	0.4	100	19.8
ES_Z6	1500		6 (IBD)	10	0.1	0.2	100	8.4
ES_Z7	2000		>IBD	10			100	

EARTH COVERED MAGAZINE ZONE OUTPUT FOR ECM 1

ECM FRONT DISTANCES					
865	1,298	1,586	2,596	4,327	7,211



ECM SIDE DISTANCES	ZONE
865	1 (K6)
1,298	2 (K9)
1,586	3 (K11)
2,596	4 (K18)
4,327	5 (K24/PTRD)
7,211	6 (K40/IBD)

Fatalities:

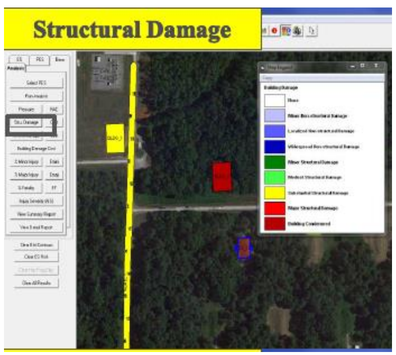
Zone 1 = 100%
Zone 2 = 90% - (0.1(K9-ES distance)/(K9-K6)+.90)
Zone 3 = 80% - (0.1(K11-ES distance)/(K11-K9)+. 80)
Zone 4 = 20% - (0.6(K18-ES distance)/(K18-K11)+.20)
Zone 5 = 2% - (0.18(PTRD-ES distance)/PTRD-K18)+.02)
Zone 6 = 1% -(0.01(IBD-ES distance)/(IBD-PTRD)+.01)

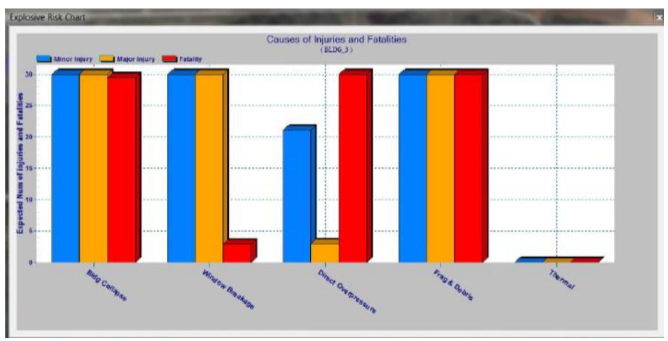
Building Damage:

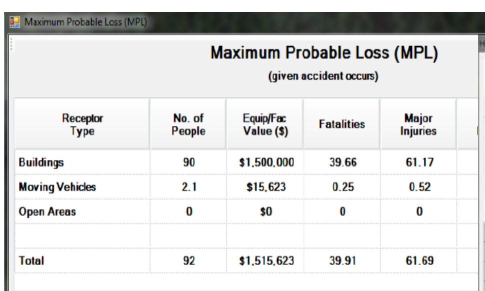
Zones 1, 2 and 3 = 100%
Zone 4 = 50% - (0.5(K18-ES distance)/(K18-K11)+0.5)
Zone 5 = 20% - (0.3(PTRD-ES distance)/PTRD-K18)+0.2)
Zone 6 = 5% - (0.15(IBD-ES distance)/(IBD-PTRD)+0.05)

Background- Tier 2a HAZX

- **Defines accident probabilities in qualitative terms**
- **Translates consequences into severity categories**
- **Consequence algorithms based on DDESB TP-14, Rev. 4**



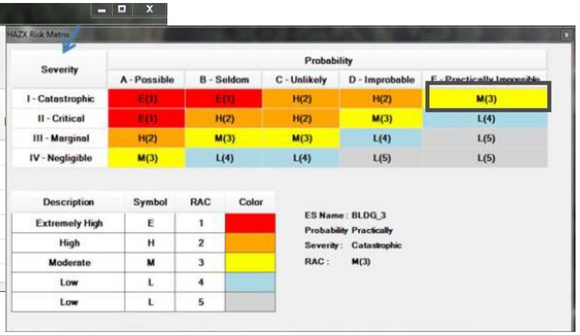




Maximum Probable Loss (MPL)

Maximum Probable Loss (MPL)
(given accident occurs)

Receptor Type	No. of People	Equip/Fac Value ($)	Fatalities	Major Injuries
Buildings	90	$1,500,000	39.66	61.17
Moving Vehicles	2.1	$15,623	0.25	0.52
Open Areas	0	$0	0	0
Total	92	$1,515,623	39.91	61.69



HAZX Risk Matrix

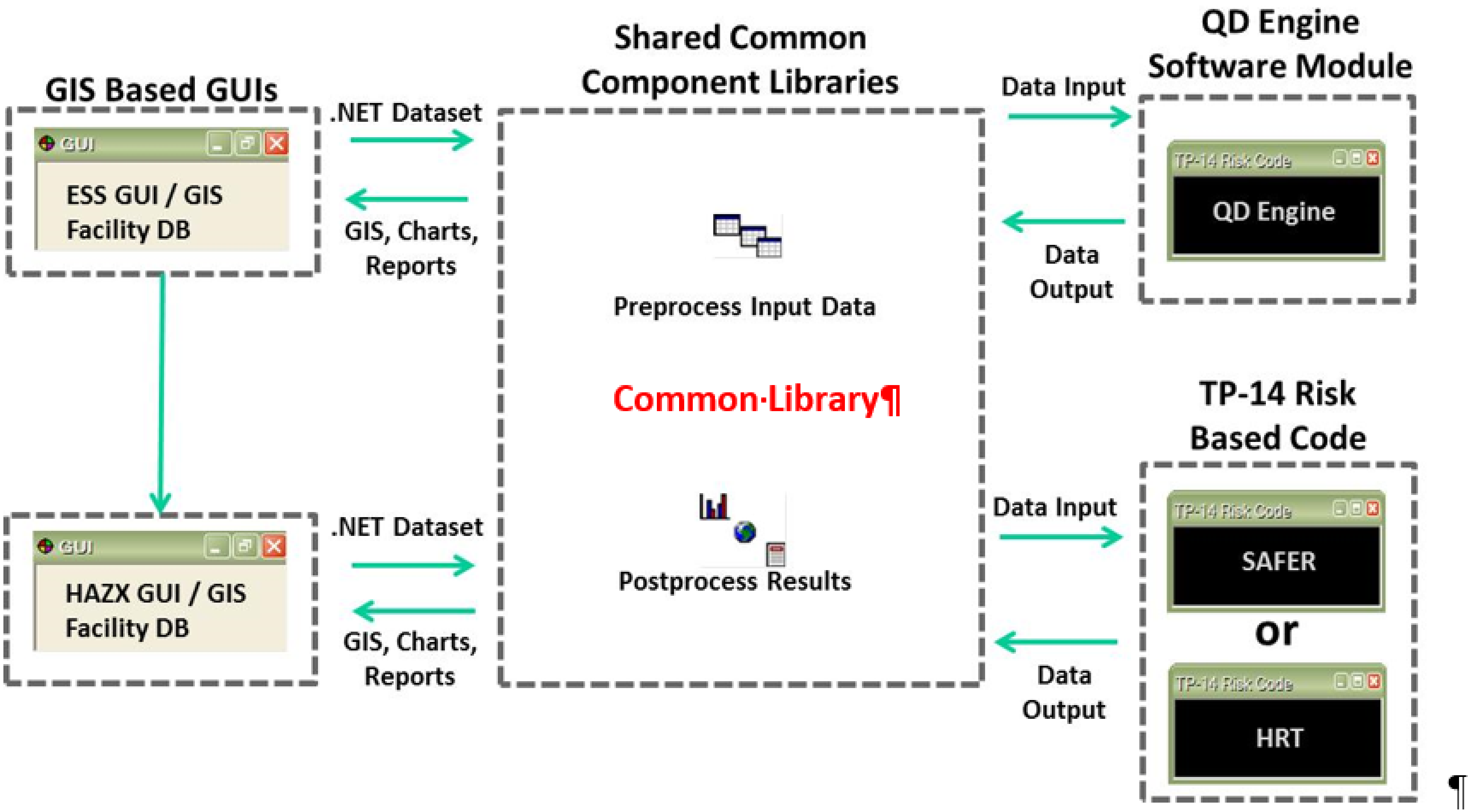
Severity	Probability				
	A - Possible	B - Seldom	C - Unlikely	D - Improbable	E - Practically Impossible
I - Catastrophic	E(1)	E(1)	H(2)	H(2)	M(3)
II - Critical	E(1)	H(2)	H(2)	M(3)	L(4)
III - Marginal	H(2)	M(3)	M(3)	L(4)	L(5)
IV - Negligible	M(3)	L(4)	L(4)	L(5)	L(5)

Description	Symbol	RAC	Color
Extremely High	E	1	
High	H	2	
Moderate	M	3	
Low	L	4	
Low	L	5	

ES Name : BLDG_3
Probability Practically
Severity : Catastrophic
RAC : M(3)

- **PES Input Requirements:**
  - **Facility Information**
    - Height
    - Structure Type
  - **Replacement Cost**
  - **Occupants**
  - **PES Activity**
- **ES Input Requirements:**
  - **Facility Information**
    - Height
    - Structure Type
    - Roof Type
    - Window
  - **Replacement Cost**
    - Building
    - Windows
  - **Occupants**
  - **Traffic Information**
  - **Barricade Polygons**

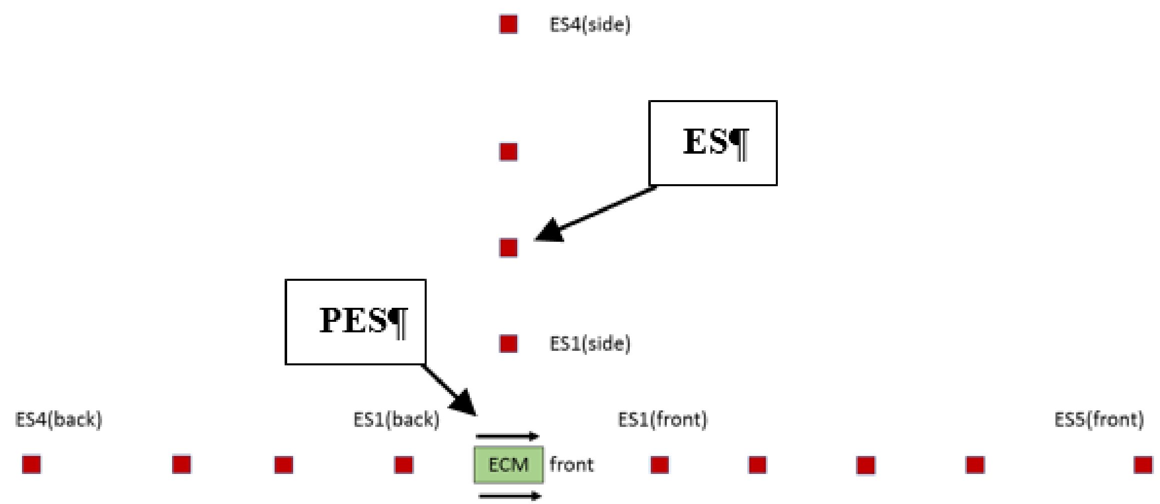
RBESS System Design



RBESS Verification

- Focus of verification was to demonstrate that RBESS was implemented as intended
- Phase I concentrated of comparing Tier 1 results for ASAP-X, HAZX (Tier 1) and RBESS
- Phase II focused on comparing Tier 2a results between HAZX and RBESS
- Each phase consisted of multiple scenarios that varied:
  - NEW
  - PES type and size
  - ES location
  - PES orientation for ECM

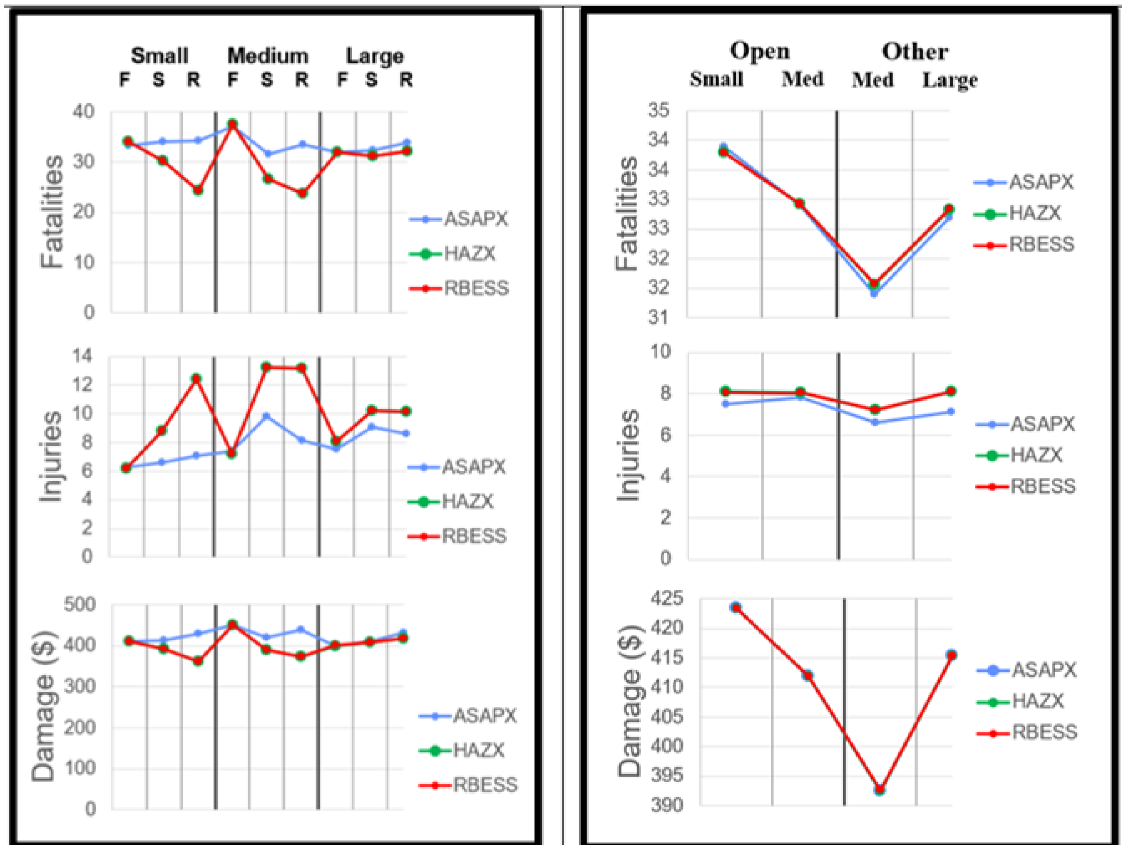
Phase I Verification Scenarios



PES Type	Charge	ID	PES Orientation	IMD-B ES 1	ILD-B ES 2	IMD_U ES 3	ILD-U ES 4	PTR ES 5	IBD ES 6	> IBD ES 7
ECM	Small (1000 lb)	S1	Front	50	75	100	150	600	1000	1400
		S2	Side	40	65	95	140	500	1050	1300
		S3	Rear	30	70	105	115	400	850	1255
	Medium (70,000 lb)	S4	Front	200	300	400	500	800	1400	1600
		S5	Side	230	350	450	650	700	1300	1500
		S6	Rear	150	325	425	480	700	1000	1255
	Large (500,000 lb)	S7	Front	450	700	800	1300	2000	3800	4500
		S8	Side	400	600	750	1400	1600	3000	5000
		S9	Rear	475	500	870	1250	1500	2500	4000
Open	Small (500 lb)	S10	Front	40	60	80	120	400	900	1300
	Medium (30,000 lb)	S11	Front	150	250	300	500	650	1000	1400
Undefined	Medium (20,00 lb)	S12	Front	100	225	275	450	700	1200	1255
	Large (100,000 lb)	S13	Front	250	400	500	700	1000	1500	2000

Phase I Verification Results

- **Nearly full agreement between HAZX and RBESS**
  - **Common Library implement properly**
- **Disagreement between ASAP-X and RBESS/HAZX for ECMs**
  - **Hazard zone calculated with QDE in RBESS/HAZX**
  - **Hazard zone calculated with simplified QD engine in ASAP-X**
- **Disagreement between ASAP-X and RBESS/HAZX for Injuries**
  - **Interpolation scheme for ASAP-X is not consistent for all hazard zone due to different rounding rules**

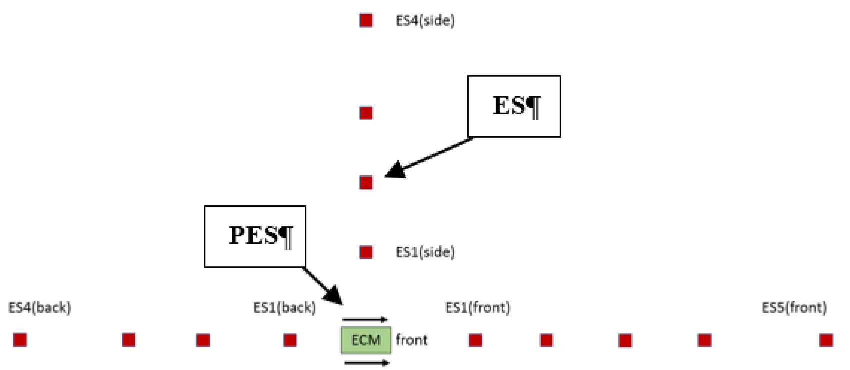


A. ECM-type PES Scenarios

B. Open- and Other-type PES Scenarios

Phase II Verification Scenarios

- 100 runs performed to test PES, NEW, and ES parameters
- Runs also used to test functionality
- Problem setup identical to Phase I runs
- Runs compared results between RBESS and HAZX
- Runs included effects of barricades and roads



PES/NEW Parameters						
PES Category	PES Type	Soil Type	Activity Type	NEW	Hazard Division	Weapon Type
Aboveground Structure (AGS)	Small	Concrete	Destruction	S (< 1000 lb)	1.1	AIM-7 Missile
	Med	Loose Soil	Maint/Assembly	M (> 1000 lb)	1.2.1	Bulk/Lt Case
	Large	None (Ships)	Operations	L (≥ 100,000 lb)	1.2.2	M107
Earth Covered Magazine (ECM)	Small Steel Arch	Rock/Hard Clay	Storage		1.2.3	MK-82
	Small RC Arch		Testing		1.3	MK-83
	Med Steel Arch		Transportation		1.4	MK-84
	Med RC Arch				1.5	Unknown
	Large Steel Arch				1.6	MK1 (1.2.1)
	Large RC Arch					
Hardened AC Structure (HAS)	HAC					
Hollow Clay Tile	Hollow Clay Tile					
ISO Container	ISO Container					
Open	Open					
Operating Building (Concrete)	Small					
	Medium					
Steel PEMB	Steel PEMB					
Ship	Small					
	Medium					
	Large					

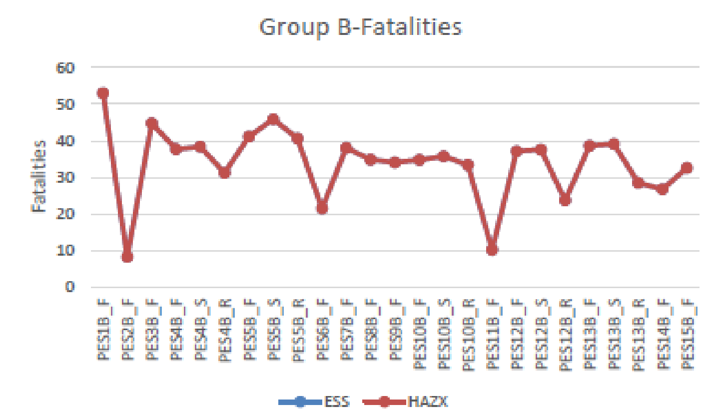
KEY
Considered in Phase 1
Recommended to be included
Not likely to be included

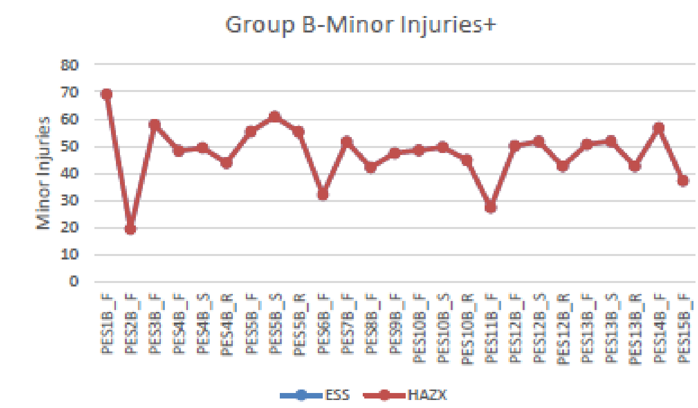
ES Parameters					
ES Category	ES Building Type	ES Roof Type	Exposure Type	Glass	% Glass
Mod Build/Trailer	Mod Build/Trailer	14" Reinforced Concrete	None	Annealed	Low (0-10%)
Open	Open	4" Reinforced Concrete	IBD	Tempered	Med (11-25%)
Vehicle	Vehicle	5/8" Gypsum Board	PTRD	Dual Pane	High (25-40%)
Reinforced Concrete	Small (Office/Comm)	3/8" Plywood + 2x10 joists	ILD		
	Medium (Office/Comm)	Light Steel Panel (22 gauge)	IMD		
	Large Tilt Up (Comm)	Lightweight Con and Steel Deck	On Base Rd		
Reinforced Masonry	Small (Office/Comm)	Medium Steel Panel (18 gauge)	Asset Presrv		
	Medium (Office/Comm)	Steel (Automobile)			
Steel PEMB	Small (Office/Storage)	Unknown			
	Medium (Office/Comm)	Wood Panelized (1/2" Plywd)			
	Large (Office/Storage/Hanger)				
Stud Wall (Wood Frame)	Small Wood Frame (Residence)				
	Med Wood Frame (Residence)				
	Medium Steel Stud				
Unreinforced Masonry	Small (Office)				
	Medium (Office)				
	Large (Office)				

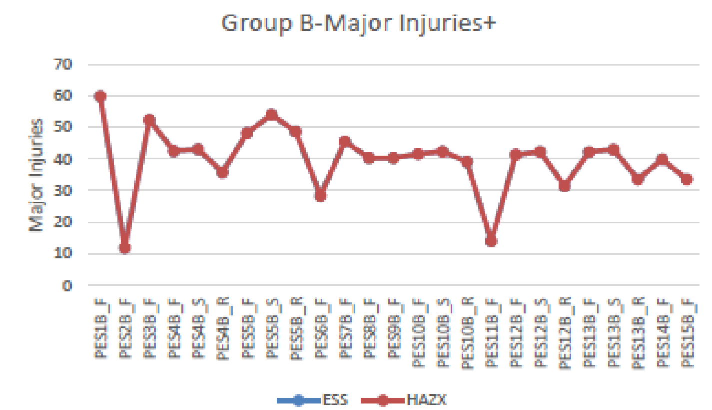
KEY
Considered in Phase 1
Recommended to be included
Not likely to be included

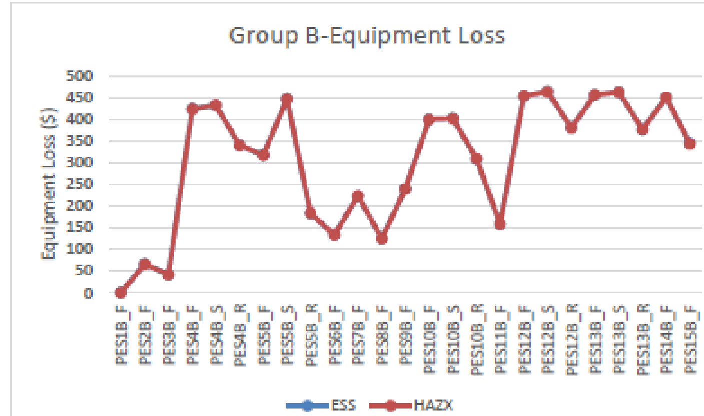
Phase II Verification Results

- **Complete agreement between RBESS and HAZX**
- **RBESS calculated a higher expected value loss than HAZX by a factor of 10 for all roads, but issue was corrected**
- **RBESS functioned as expected**





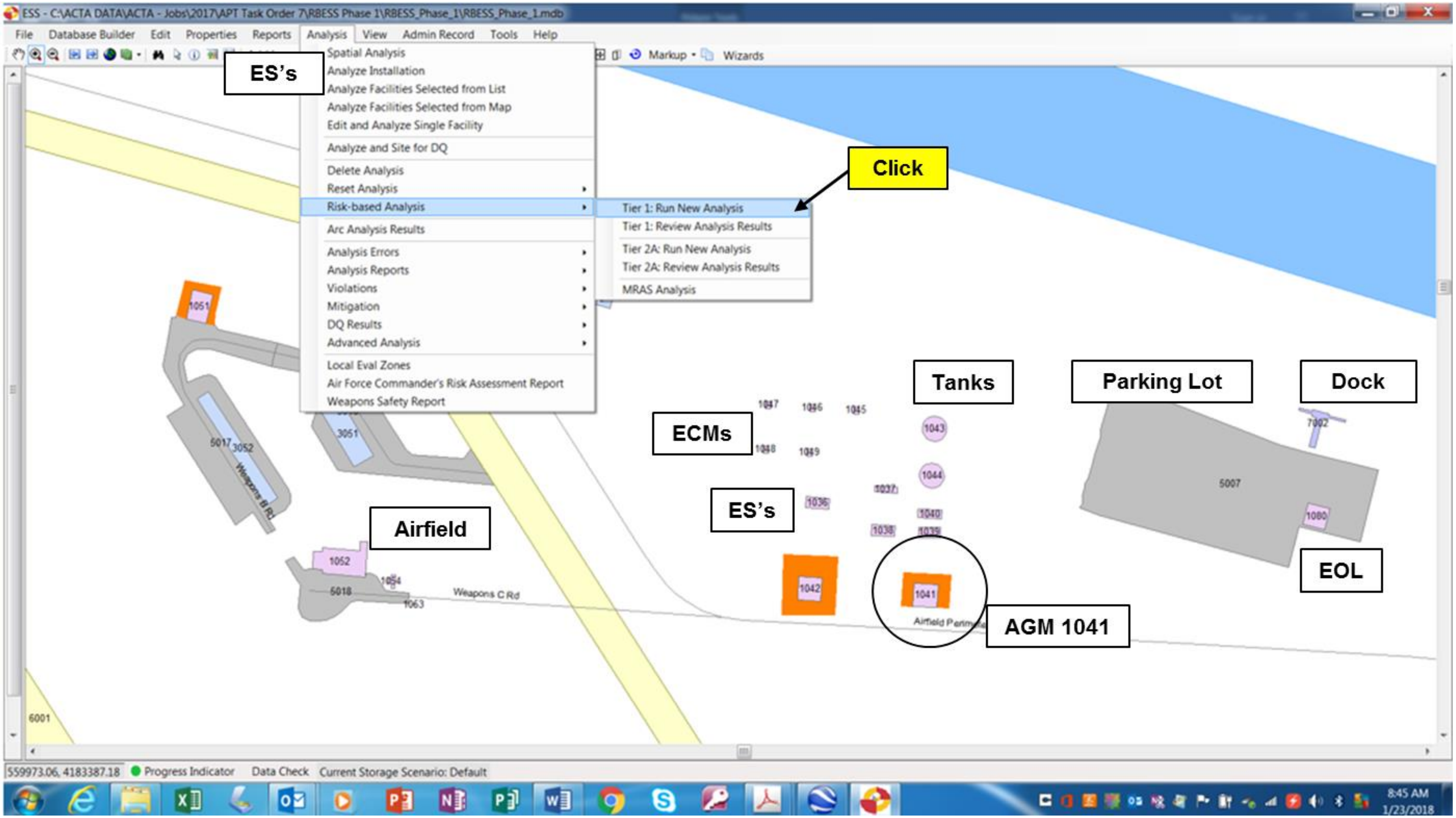




RBESS Demonstration

- **Demonstration of Tier 1 and Tier 2a follows**
- **Alameda Naval Air Station used for example**
- **Barricade was included**

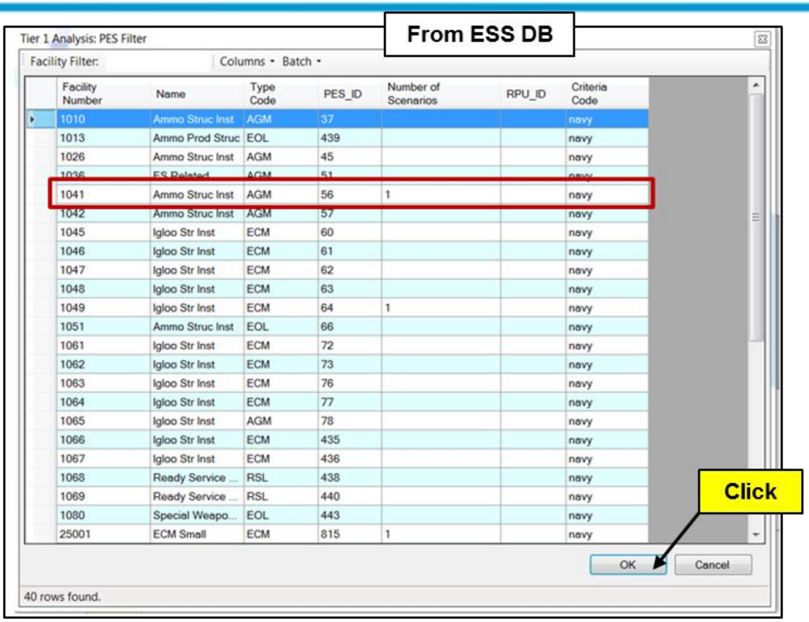
RBESS Tier 1 AGM 1041 Project



NAVFAC EXWC: Technology Driven, Warfighter Focused

RBESS Tier 1 Demonstration

PES Selection Screen



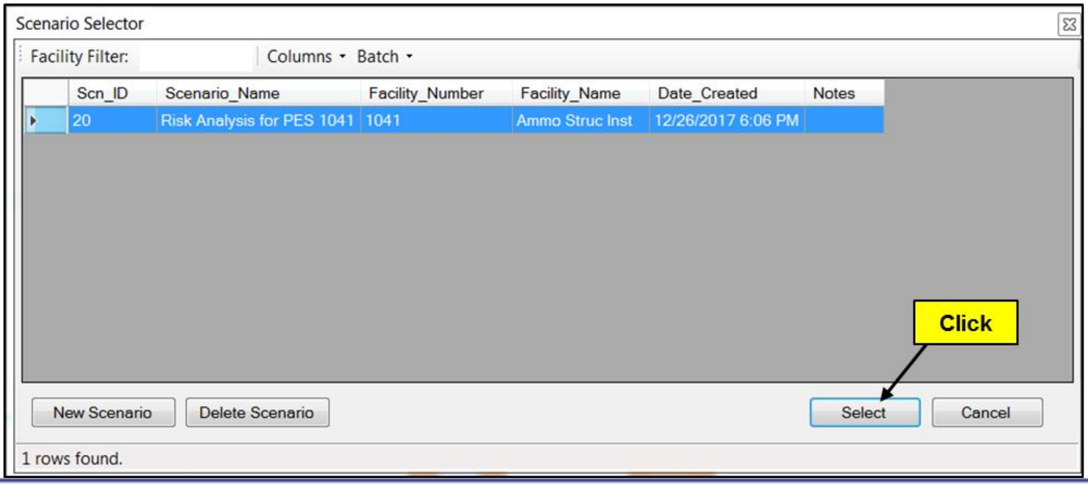
Tier 1 Analysis: PES Filter

Facility Filter: Columns Batch

Facility Number	Name	Type Code	PES_ID	Number of Scenarios	RPU_ID	Criteria Code
1010	Ammo Struc Inst	AGM	37			navy
1013	Ammo Prod Struc	EOL	439			navy
1026	Ammo Struc Inst	AGM	45			navy
1036	ES Related	AGM	51			navy
1041	Ammo Struc Inst	AGM	56	1		navy
1042	Ammo Struc Inst	AGM	57			navy
1045	Igloo Str Inst	ECM	60			navy
1046	Igloo Str Inst	ECM	61			navy
1047	Igloo Str Inst	ECM	62			navy
1048	Igloo Str Inst	ECM	63			navy
1049	Igloo Str Inst	ECM	64	1		navy
1051	Ammo Struc Inst	EOL	66			navy
1061	Igloo Str Inst	ECM	72			navy
1062	Igloo Str Inst	ECM	73			navy
1063	Igloo Str Inst	ECM	76			navy
1064	Igloo Str Inst	ECM	77			navy
1065	Igloo Str Inst	AGM	78			navy
1066	Igloo Str Inst	ECM	435			navy
1067	Igloo Str Inst	ECM	436			navy
1068	Ready Service ...	RSL	438			navy
1069	Ready Service ...	RSL	440			navy
1080	Special Weapo...	EOL	443			navy
25001	ECM Small	ECM	815	1		navy

OK Cancel

40 rows found.



Scenario Selector

Facility Filter: Columns Batch

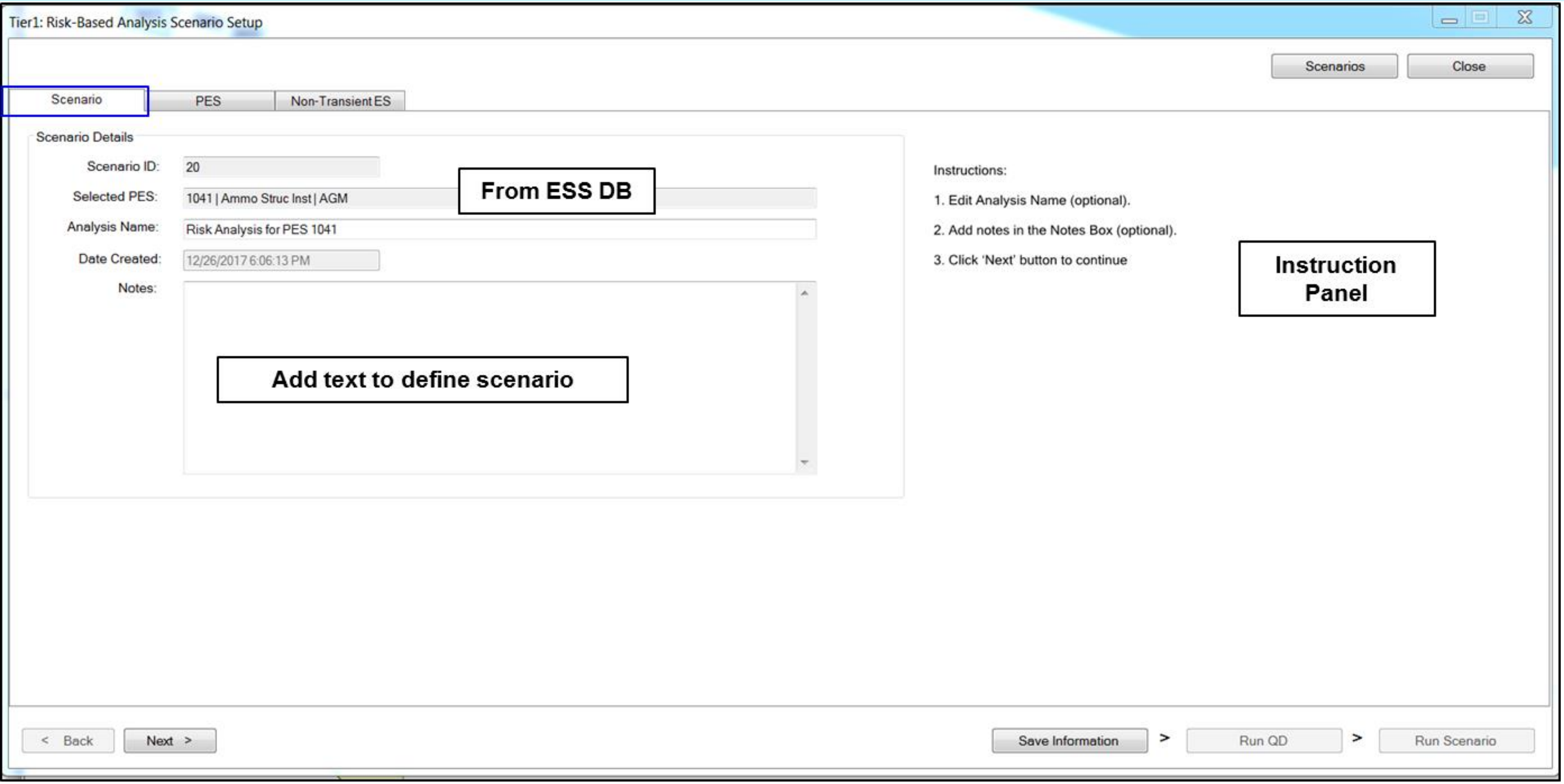
Scn_ID	Scenario_Name	Facility_Number	Facility_Name	Date_Created	Notes
20	Risk Analysis for PES 1041	1041	Ammo Struc Inst	12/26/2017 6:06 PM	

New Scenario Delete Scenario Select Cancel

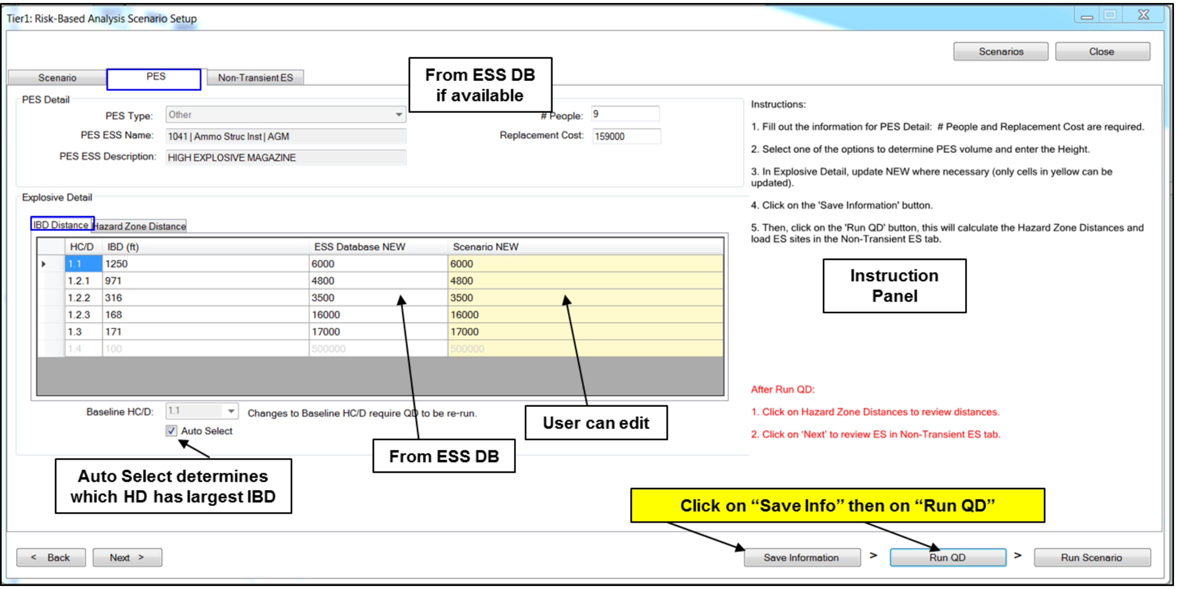
1 rows found.

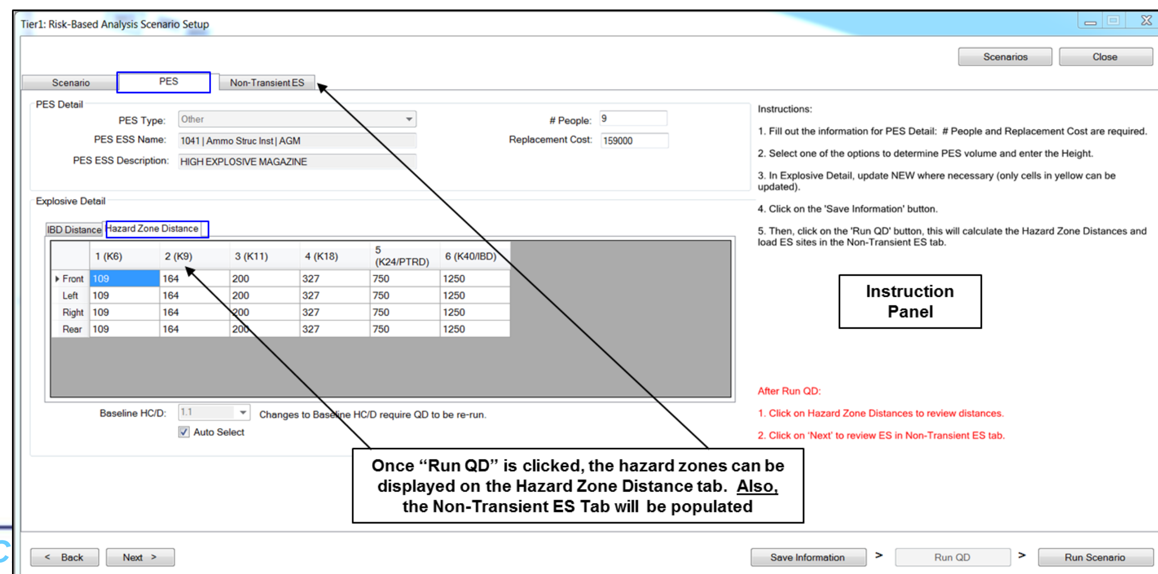
Scenario Selector Screen

RBESS Tier 1 Scenario Setup Screen (Scenario Tab)



RBESS Tier 1 Scenario Setup Screen
(PES Tab - IBD Distance & Hazard Zone Distances Sub-Tabs)





RBESS Tier 1 Scenario Setup Screen
(Non-Transient ES Tab)

User can edit the radius within which ES's will be evaluated: a factor on IBD

User can select which ES's within evaluation zone will be included in analysis

Tier1: Risk-Based Analysis Scenario Setup

Include in Scenario: RBESS Eval Zone: 1.2 Additional Options: All facilities within evaluation zone

- All facilities within evaluation zone
- All facilities in violation (mitigated or not)
- Only facilities in violation and not mitigated

Scenarios | Close

Scenario | PES | Non-Transient ES

Select ES for RBESS Analy [From ESS DB] **listed below from current ESS Spatial Analysis Zone):**

From ESS DB

		Facility #	Desc	Max # of People	Height (ft)	Total Cost	On Base	Exposure Type
01	☑	1036	HIGH EXPLOSIVE MAGAZINE	10	15	400000	☑	IMD(U)
02	☑	1037	GENERAL STORAGE SHED (Demolished)	10	15	400000	☑	ILD(U)
03	☑	1038	GENERAL STORAGE SHED	10	15	400000	☑	IBD
04	☑	1039	GENERAL STORAGE SHED	10	15	400000	☑	IBD
05	☑	1040	GENERAL STORAGE SHED	10	15	400000	☑	IBD
06	☑	1042	HIGH EXPLOSIVE MAGAZINE	10	15	159000	☑	IMD(U)
07	☑	1043	DEMOLISHED WATER TANK	10	15	400000	☑	IBD
08	☑	1044	DEMOLISHED WATER TANK	10	15	400000	☑	IBD
09	☑	1045	HIGH EXPLOSIVE MAGAZINE	10	15	123600	☑	IMD(B)
10	☑	1046	HIGH EXPLOSIVE MAGAZINE	10	15	123600	☑	IMD(B)
11	☑	1047	HIGH EXPLOSIVE MAGAZINE	10	15	123600	☑	IMD(B)
12	☑	1048	12x17 Box ECM	10	15	123600	☑	IMD(B)
13	☑	1049	12x17 Box ECM	10	15	123600	☑	IMD(B)
14	☑	1050	INERT STOREHOUSE	10	15	400000	☑	IBD
15	☑	1052	ADMINISTRATIVE OFFICE (Demolished)	10	15	400000	☑	IBD
16	☑	1053	Guard Shack	10	15	400000	☑	IBD
17	☑	1054	GATE / SENTRY HOUSE	10	15	400000	☑	IBD
18	☑	1080	SPECIAL WEAPONS SHOP	10	15	400000	☑	IBD

Instruction Panel

Instructions:

1. Review Non-Transient ES to be included in scenario.
2. Update information where necessary (only cells in yellow can be edited)
3. Click on 'Save Information'
4. Click on 'Run Scenario'

Optional:

Use the 'Next' and 'Back' buttons to review information on the Non-Transient ES and PES tabs.

Set ratio for RBESS Eval Zone (default is 1.2).

In Additional Option, select option for ES (Exposed Sites).

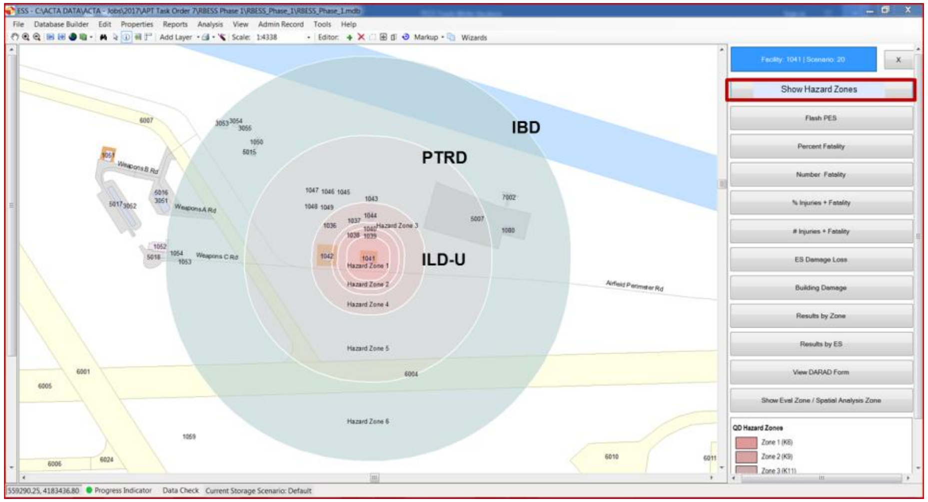
If either of the options listed above are updated, click the 'Save Information' button, then the 'Run Scenario

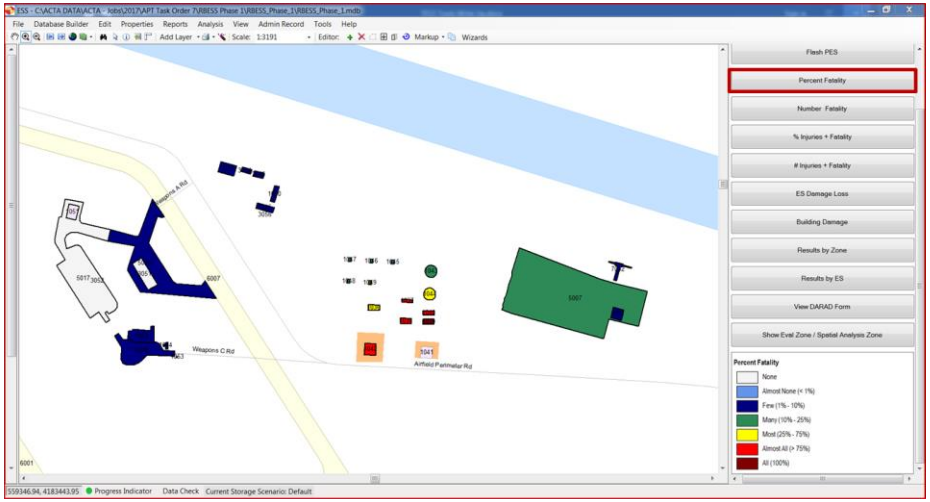
When done, click on "Run Scenario"

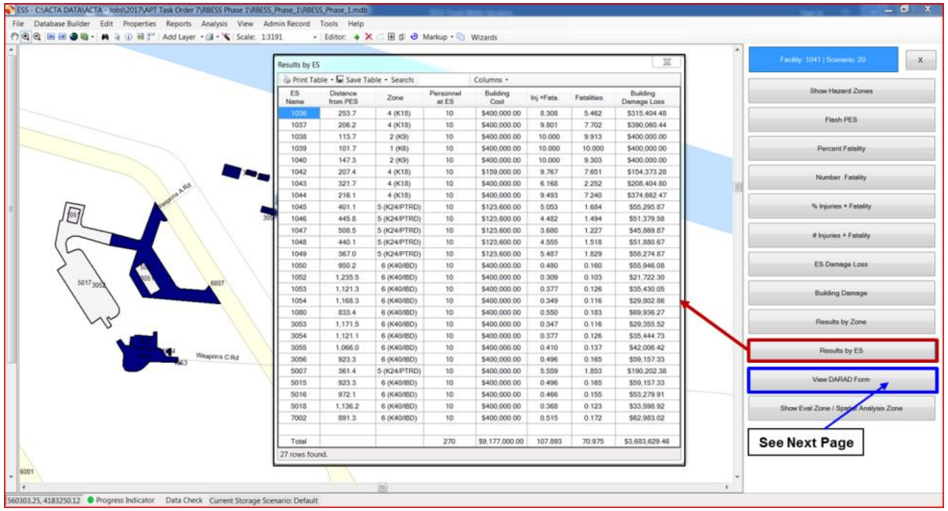
< Back | Next > | Save Information > Run QD > Run Scenario

If data are available from ESS DB, the ES attributes will be filled in; otherwise, default values are displayed. User can also edit the values

RBESS Tier 1 Analysis Results



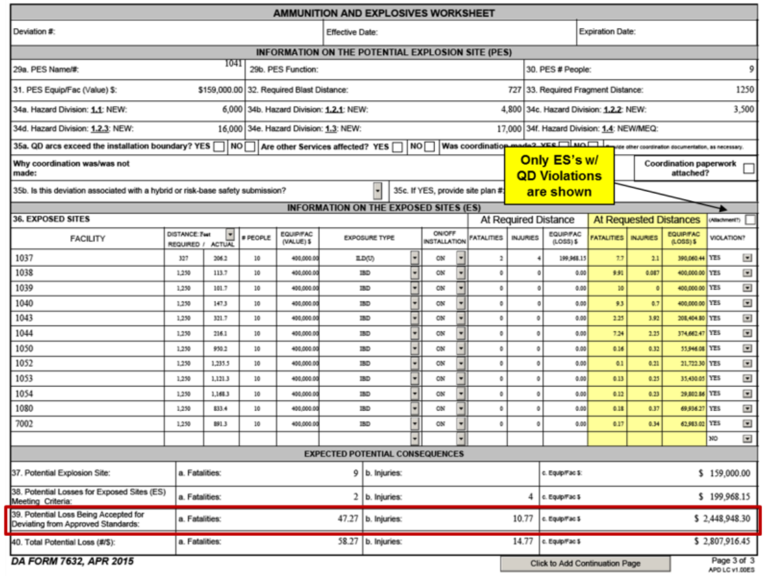




Results by ES

ES Name	Distance from PES	Zone	Personnel at ES	Building Cost	Inj.+Fata.	Fatalities	Building Damage Loss
1036	253.7	4 (K18)	10	$400,000.00	8.308	5.462	$315,404.48
1037	206.2	4 (K18)	10	$400,000.00	9.801	7.702	$390,060.44
1038	113.7	2 (K9)	10	$400,000.00	10.000	9.913	$400,000.00
1039	101.7	1 (K6)	10	$400,000.00	10.000	10.000	$400,000.00
1040	147.3	2 (K9)	10	$400,000.00	10.000	9.303	$400,000.00
1042	207.4	4 (K18)	10	$159,000.00	9.767	7.651	$154,373.28
1043	321.7	4 (K18)	10	$400,000.00	6.168	2.252	$208,404.80
1044	216.1	4 (K18)	10	$400,000.00	9.493	7.240	$374,662.47
1045	401.1	5 (K24/PTRD)	10	$123,600.00	5.053	1.684	$55,295.87
1046	445.8	5 (K24/PTRD)	10	$123,600.00	4.482	1.494	$51,379.58
1047	508.5	5 (K24/PTRD)	10	$123,600.00	3.680	1.227	$45,869.87
1048	440.1	5 (K24/PTRD)	10	$123,600.00	4.555	1.518	$51,880.67
1049	367.0	5 (K24/PTRD)	10	$123,600.00	5.487	1.829	$58,274.87
1050	950.2	6 (K40/IBD)	10	$400,000.00	0.480	0.160	$55,946.08
1052	1,235.5	6 (K40/IBD)	10	$400,000.00	0.309	0.103	$21,722.30
1053	1,121.3	6 (K40/IBD)	10	$400,000.00	0.377	0.126	$35,430.05
1054	1,168.3	6 (K40/IBD)	10	$400,000.00	0.349	0.116	$29,802.86
1080	833.4	6 (K40/IBD)	10	$400,000.00	0.550	0.183	$69,936.27
3053	1,171.5	6 (K40/IBD)	10	$400,000.00	0.347	0.116	$29,355.52
3054	1,121.1	6 (K40/IBD)	10	$400,000.00	0.377	0.126	$35,444.73
3055	1,066.0	6 (K40/IBD)	10	$400,000.00	0.410	0.137	$42,006.42
3056	923.3	6 (K40/IBD)	10	$400,000.00	0.496	0.165	$59,157.33
5007	361.4	5 (K24/PTRD)	10	$400,000.00	5.559	1.853	$190,202.38
5015	923.3	6 (K40/IBD)	10	$400,000.00	0.496	0.165	$59,157.33
5016	972.1	6 (K40/IBD)	10	$400,000.00	0.466	0.155	$53,279.91
5018	1,136.2	6 (K40/IBD)	10	$400,000.00	0.368	0.123	$33,598.92
7002	891.3	6 (K40/IBD)	10	$400,000.00	0.515	0.172	$62,983.02
Total			270	$9,177,000.00	107.893	70.975	$3,683,629.46

27 rows found.



AMMUNITION AND EXPLOSIVES WORKSHEET

Deviation #:	Effective Date:	Expiration Date:

INFORMATION ON THE POTENTIAL EXPLOSION SITE (PES)

29a. PES Name/#: 1041	29b. PES Function:	30. PES # People: 9
31. PES Equip/Fac (Value) $: $159,000.00	32. Required Blast Distance: 727	33. Required Fragment Distance: 1250
34a. Hazard Division: 1.1: NEW: 6,000	34b. Hazard Division: 1.2.1: NEW: 4,800	34c. Hazard Division: 1.2.2: NEW: 3,500
34d. Hazard Division: 1.2.3: NEW: 16,000	34e. Hazard Division: 1.3: NEW: 17,000	34f. Hazard Division: 1.4: NEW/MEQ:

35a. QD arcs exceed the installation boundary? YES ☐ NO ☐ Are other Services affected? YES ☐ NO ☐ Was coordination made? YES ☐ NO ☐

Why coordination was/was not made:

Coordination paperwork attached? ☐

35b. Is this deviation associated with a hybrid or risk-base safety submission?

35c. If YES, provide site plan #:

Only ES's w/ QD Violations are shown

INFORMATION ON THE EXPOSED SITES (ES)

36. EXPOSED SITES

FACILITY	DISTANCE: Feet REQUIRED	ACTUAL	# PEOPLE	EQUIP/FAC (VALUE) $	EXPOSURE TYPE	ON/OFF INSTALLATION	At Required Distance: FATALITIES	INJURIES	EQUIP/FAC (LOSS) $	At Requested Distances: FATALITIES	INJURIES	EQUIP/FAC (LOSS) $	VIOLATION?
1037	327	206.2	10	400,000.00	ILD(U)	ON	2	4	199,968.15	7.7	2.1	390,060.44	YES
1038	1,250	113.7	10	400,000.00	IBD	ON	0	0	0.00	9.91	0.087	400,000.00	YES
1039	1,250	101.7	10	400,000.00	IBD	ON	0	0	0.00	10	0	400,000.00	YES
1040	1,250	147.3	10	400,000.00	IBD	ON	0	0	0.00	9.3	0.7	400,000.00	YES
1043	1,250	321.7	10	400,000.00	IBD	ON	0	0	0.00	2.25	3.92	208,404.80	YES
1044	1,250	216.1	10	400,000.00	IBD	ON	0	0	0.00	7.24	2.25	374,662.47	YES
1050	1,250	950.2	10	400,000.00	IBD	ON	0	0	0.00	0.16	0.32	55,946.08	YES
1052	1,250	1,235.5	10	400,000.00	IBD	ON	0	0	0.00	0.1	0.21	21,722.30	YES
1053	1,250	1,121.3	10	400,000.00	IBD	ON	0	0	0.00	0.13	0.25	35,430.05	YES
1054	1,250	1,168.3	10	400,000.00	IBD	ON	0	0	0.00	0.12	0.23	29,802.86	YES
1080	1,250	833.4	10	400,000.00	IBD	ON	0	0	0.00	0.18	0.37	69,936.27	YES
7002	1,250	891.3	10	400,000.00	IBD	ON	0	0	0.00	0.17	0.34	62,983.02	YES
													NO

EXPECTED POTENTIAL CONSEQUENCES

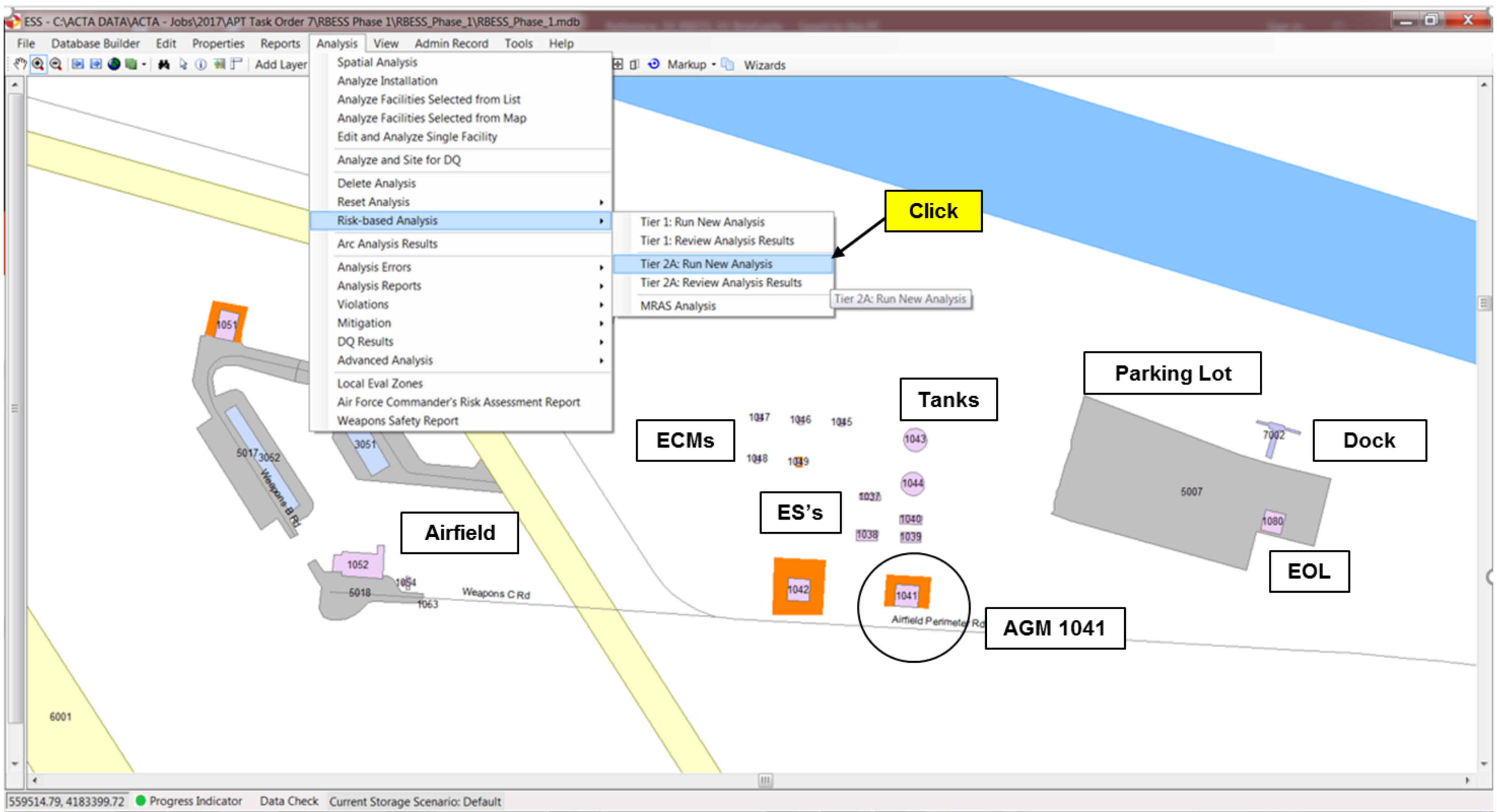
37. Potential Explosion Site:	a. Fatalities: 9	b. Injuries:	c. Equip/Fac $: $ 159,000.00
38. Potential Losses for Exposed Sites (ES) Meeting Criteria:	a. Fatalities: 2	b. Injuries: 4	c. Equip/Fac $ $ 199,968.15
39. Potential Loss Being Accepted for Deviating from Approved Standards:	a. Fatalities: 47.27	b. Injuries: 10.77	c. Equip/Fac $ $ 2,448,948.30
40. Total Potential Loss (#/$):	a. Fatalities: 58.27	b. Injuries: 14.77	c. Equip/Fac $ $ 2,807,916.45

DA FORM 7632, APR 2015 — Click to Add Continuation Page — Page 3 of 3 APD LC v1.00ES

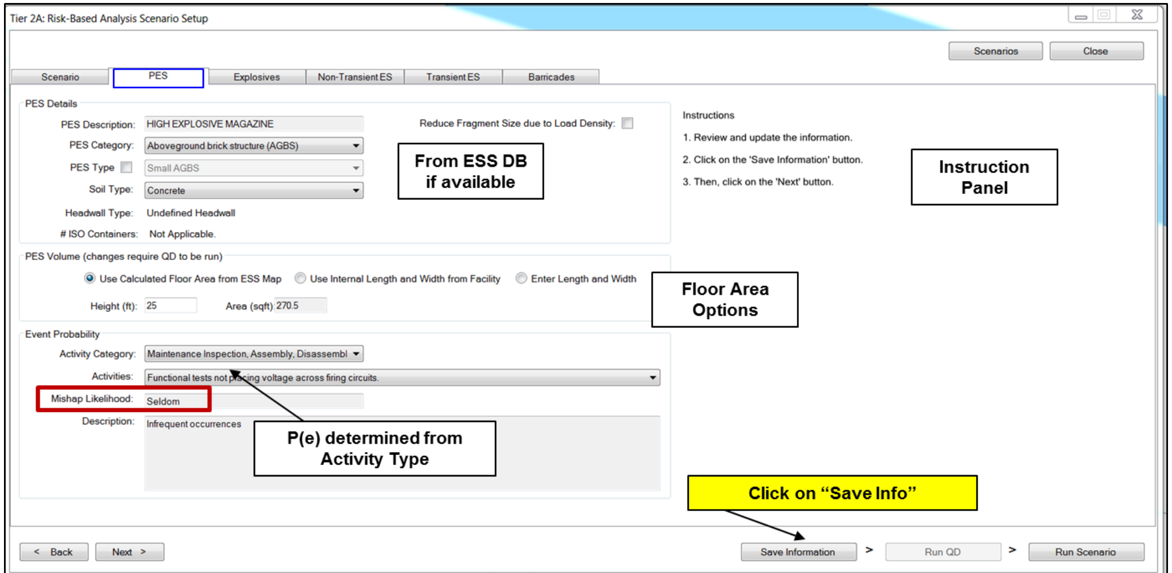
Δ_Risk Losses due to QD violations

RBESS Tier 2a AGM 1041 Project

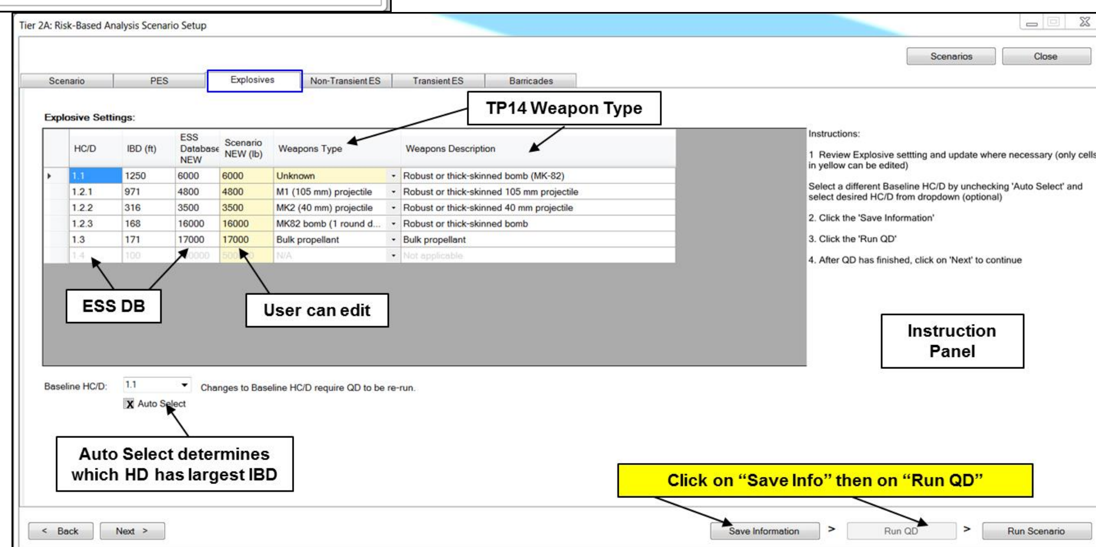
- The same project developed for Tier 1 can be used to do a Tier 2a analysis
- Simply select: run a Tier 2a analysis
- Selecting a PES & scenario are identical to Tier 1 (so not shown)



RBESS Tier 2a Scenario Setup Screen (PES Tab & Explosives Tab)

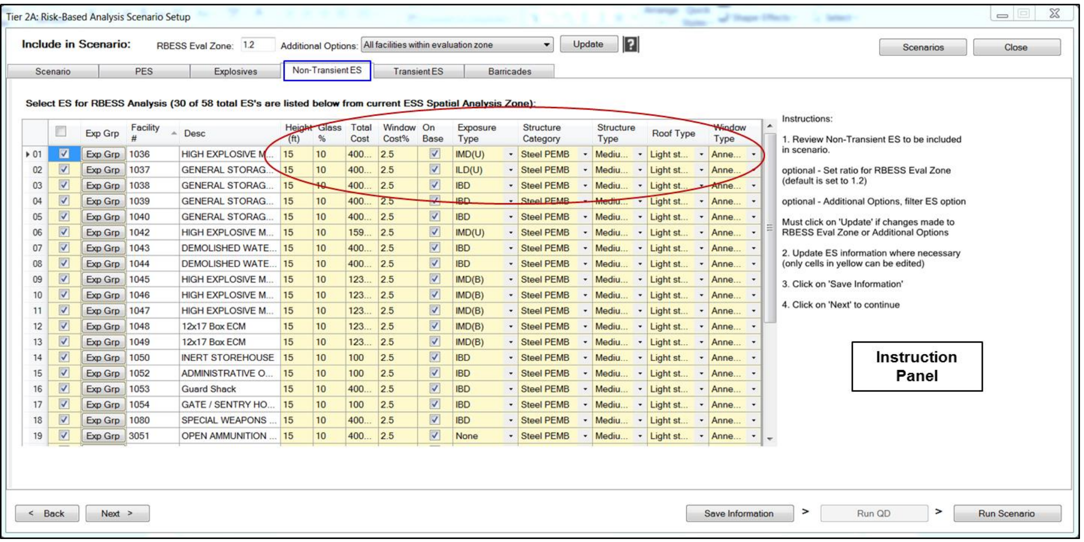


- **For Tier 2a, the PES activity type determines the P(event) that is used to develop a Risk Matrix [P(e) vs. Severity]**

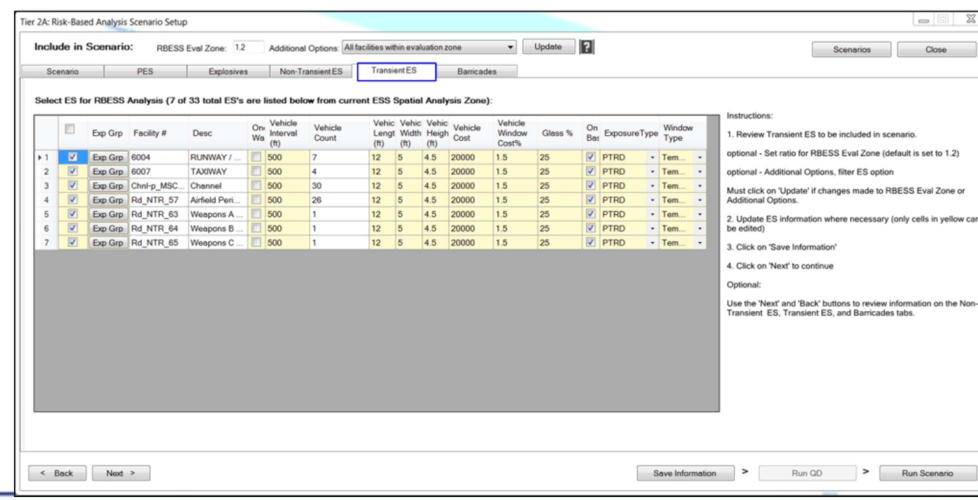


RBESS Tier 2a Scenario Setup Screen (Non-Transient & Transient ES Tab)

User can enter TP14 ES attributes or accept defaults `

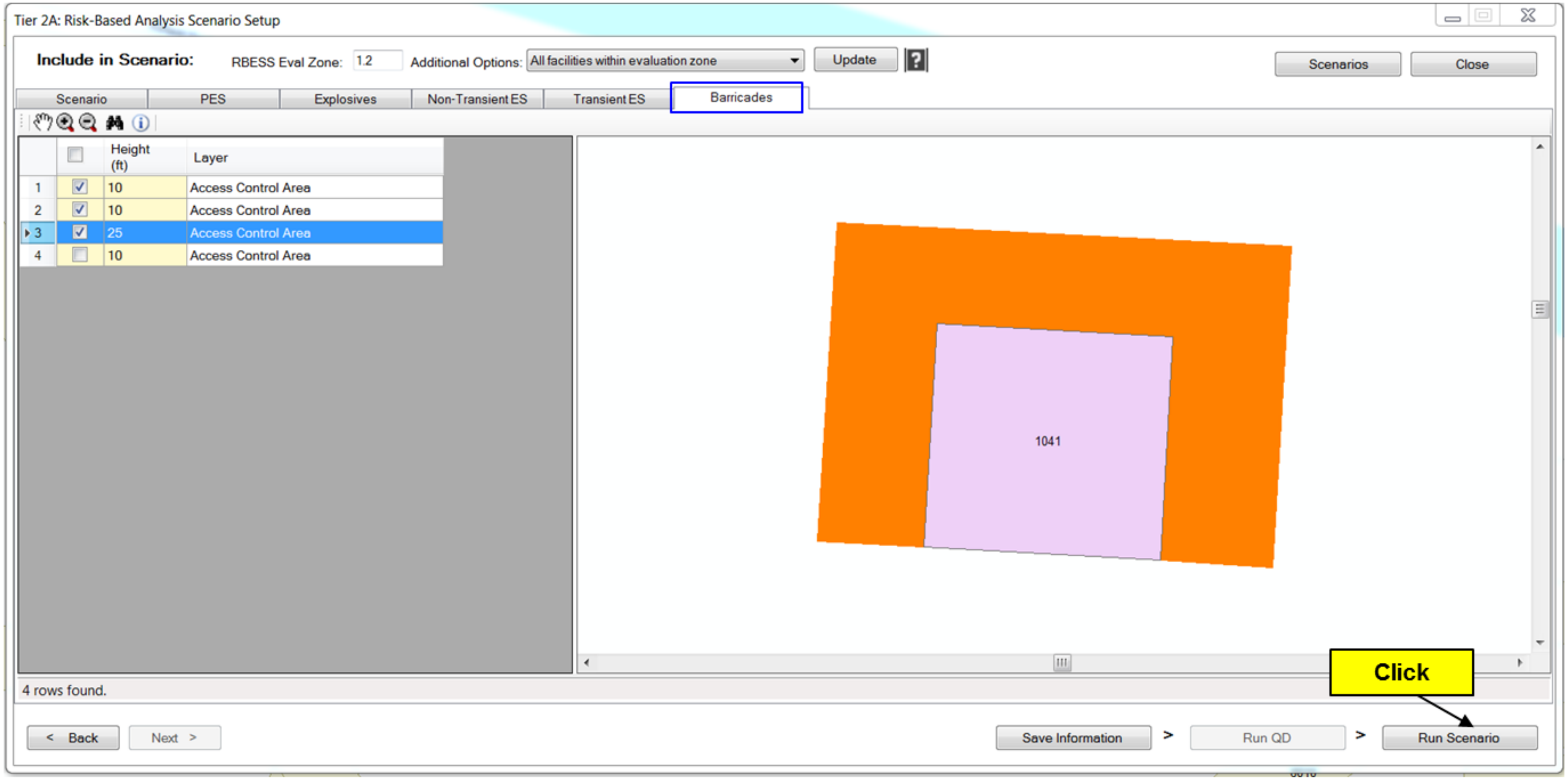


Roads, runways, shipping lanes can be defined at the Tier 2a level



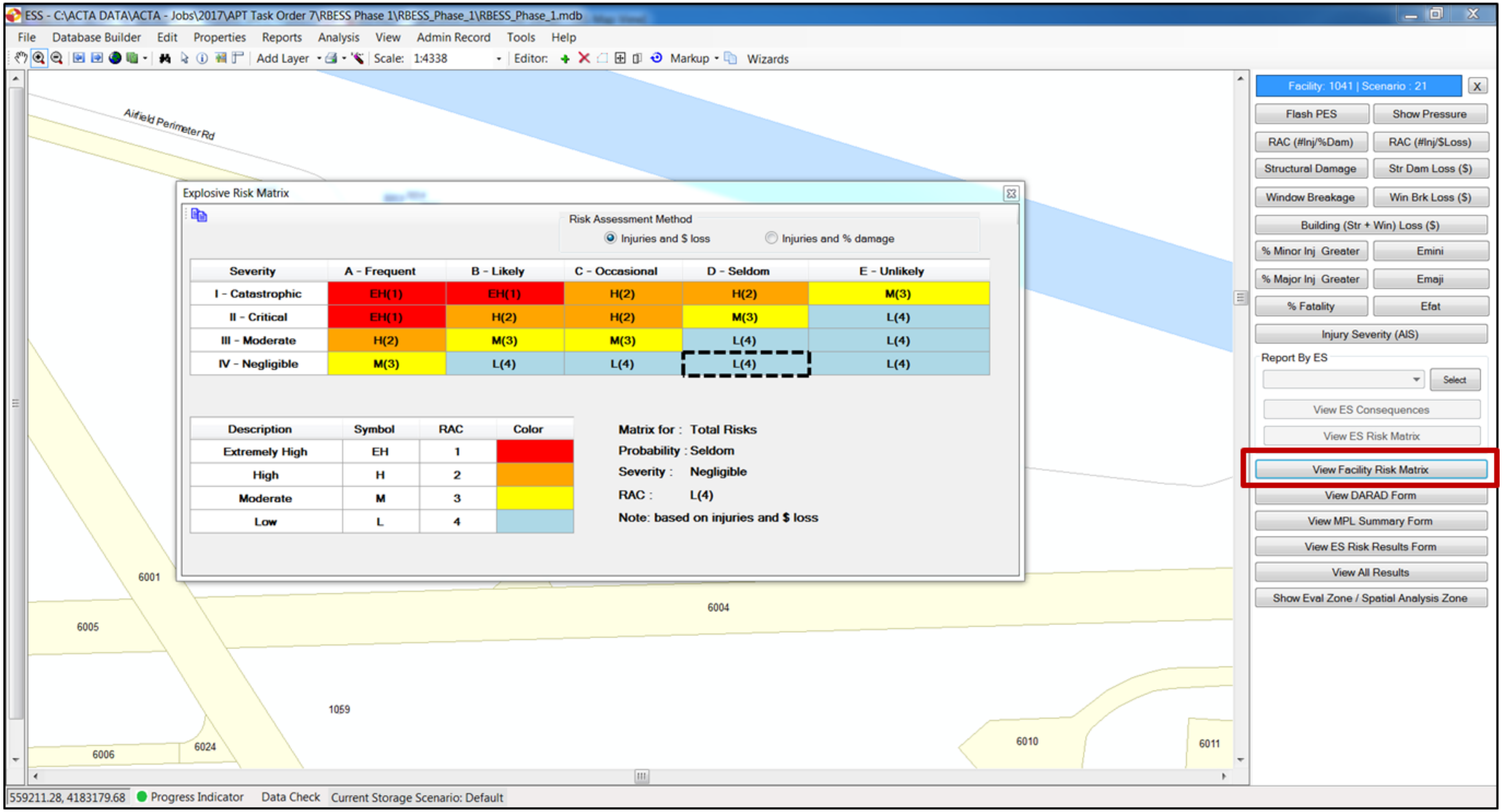
RBESS Tier 2a Scenario Setup Screen (Barricade Tab)

TP14 barricades, berms, etc. that can block PES debris/fragment throw can be defined at the Tier 2a level



RBESS Tier 2a Results

Tier 2a has numerous displays and reports including the Risk Matrix shown below. Consequences are available for each ES and a DARAD form can be generated



Conclusions

- RBESS Tier 1 and Tier 2a modes have been implemented in ESS.
- Output for both Tier 1 and Tier 2a RBESS include color-coded maps that display information on replacement cost, fatalities, and injuries.
- Output also displays consequence information for individual ES's as well as summary information for all the ES's affected by the PES.
- Both tiers of RBESS automatically populate the Department of Army (DA) Form 7632 which is known as the Deviation Approval and Risk Acceptance Document (DARAD).
- RBESS has been validated through comparisons with ASAP-X and HAZX for Tier 1 and 2a and has been shown to generate the expected results.
- RBESS is being released in ESS v6.1.4 and will be available to ESS users in the near future.

Questions?