

ioMosaic®

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The Mechanics of a QRA – A Detailed Look into an Automated QRA Process

by

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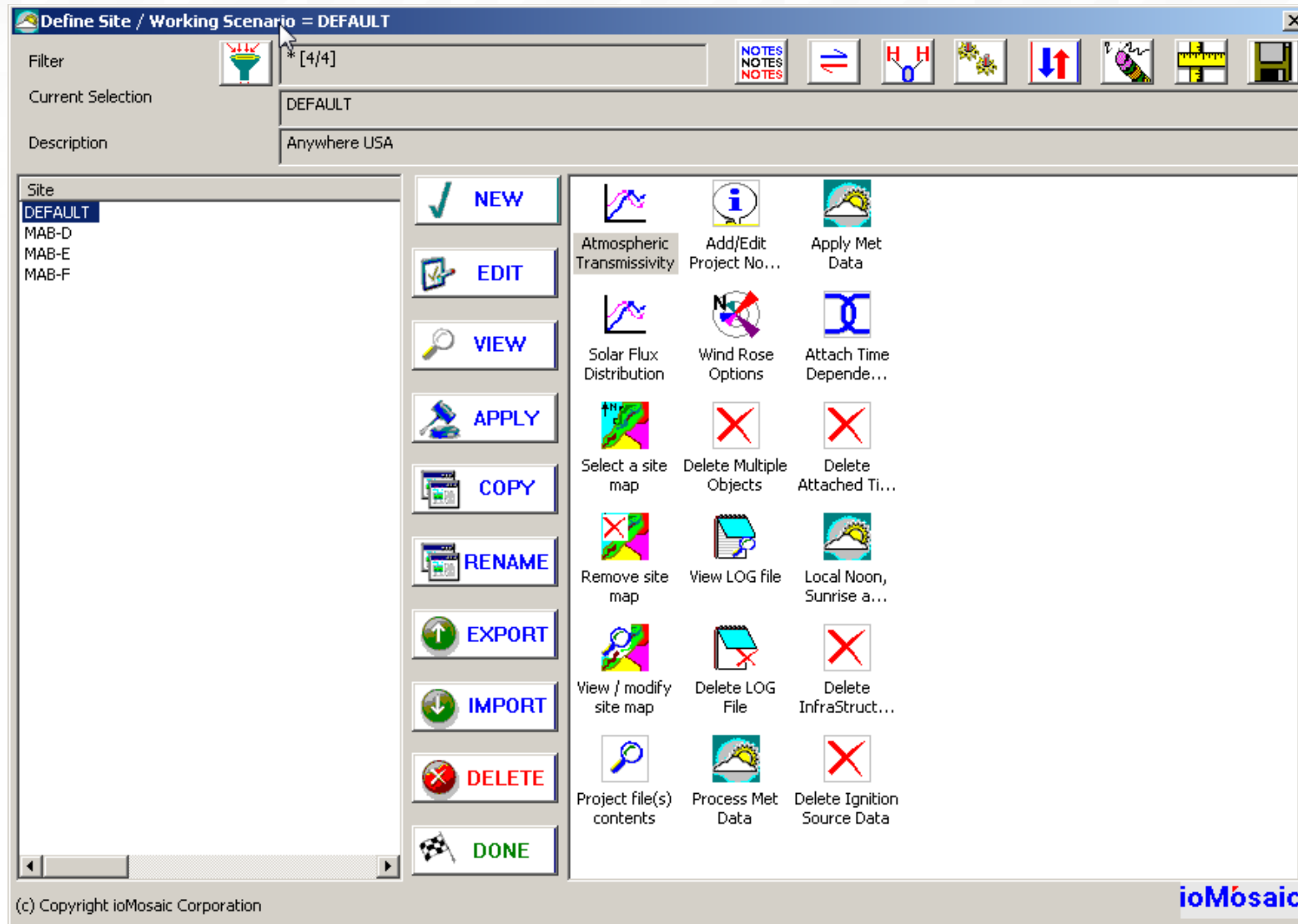
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Process Safety Office[®] SuperChems[™] provides a versatile Quantitative Risk Assessment (QRA) model for fixed facilities and transportation

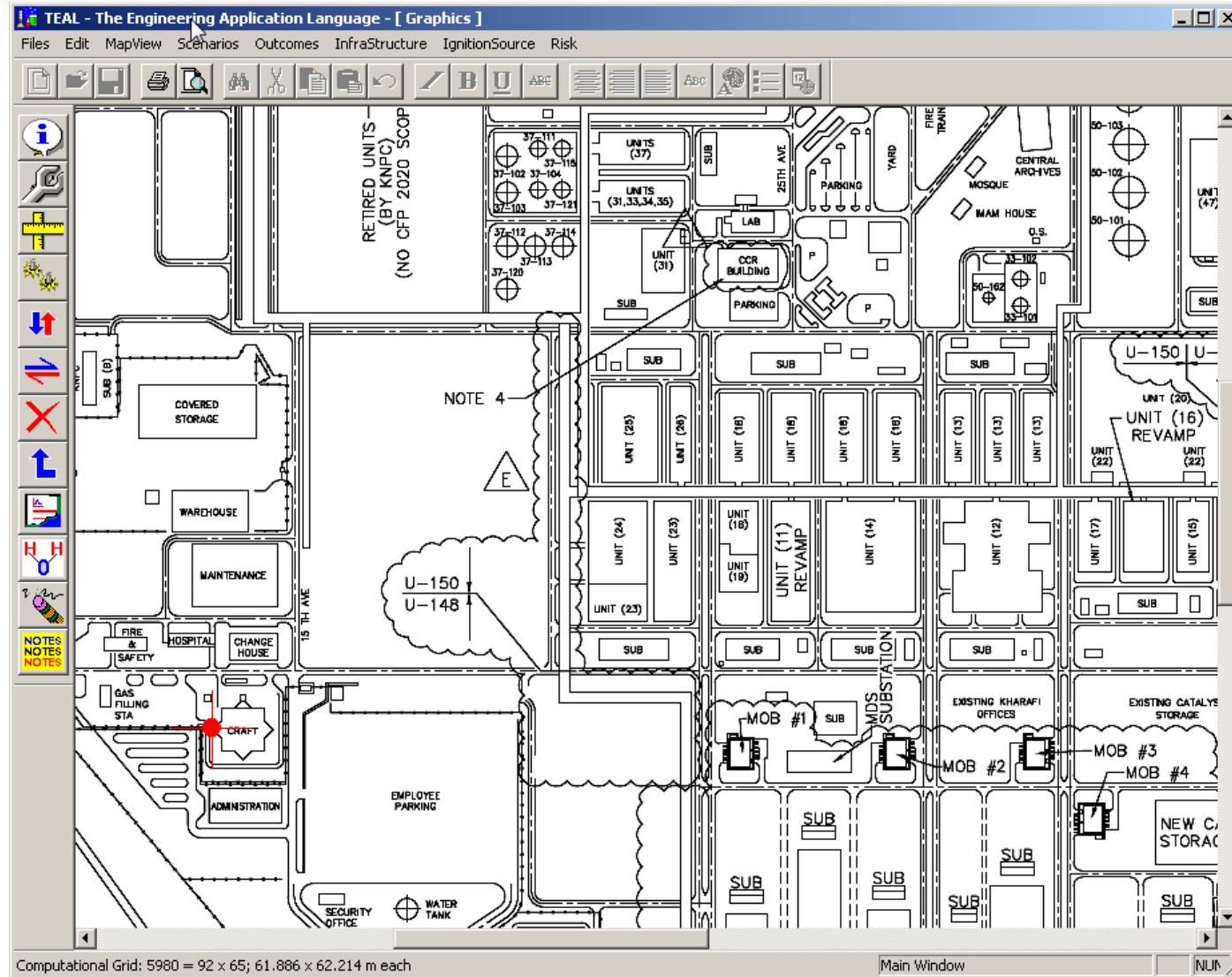
- Individual risk
- Societal risk
- Financial risk
- Facility siting

The first step of a QRA begins by establishing site, meteorological, and population data



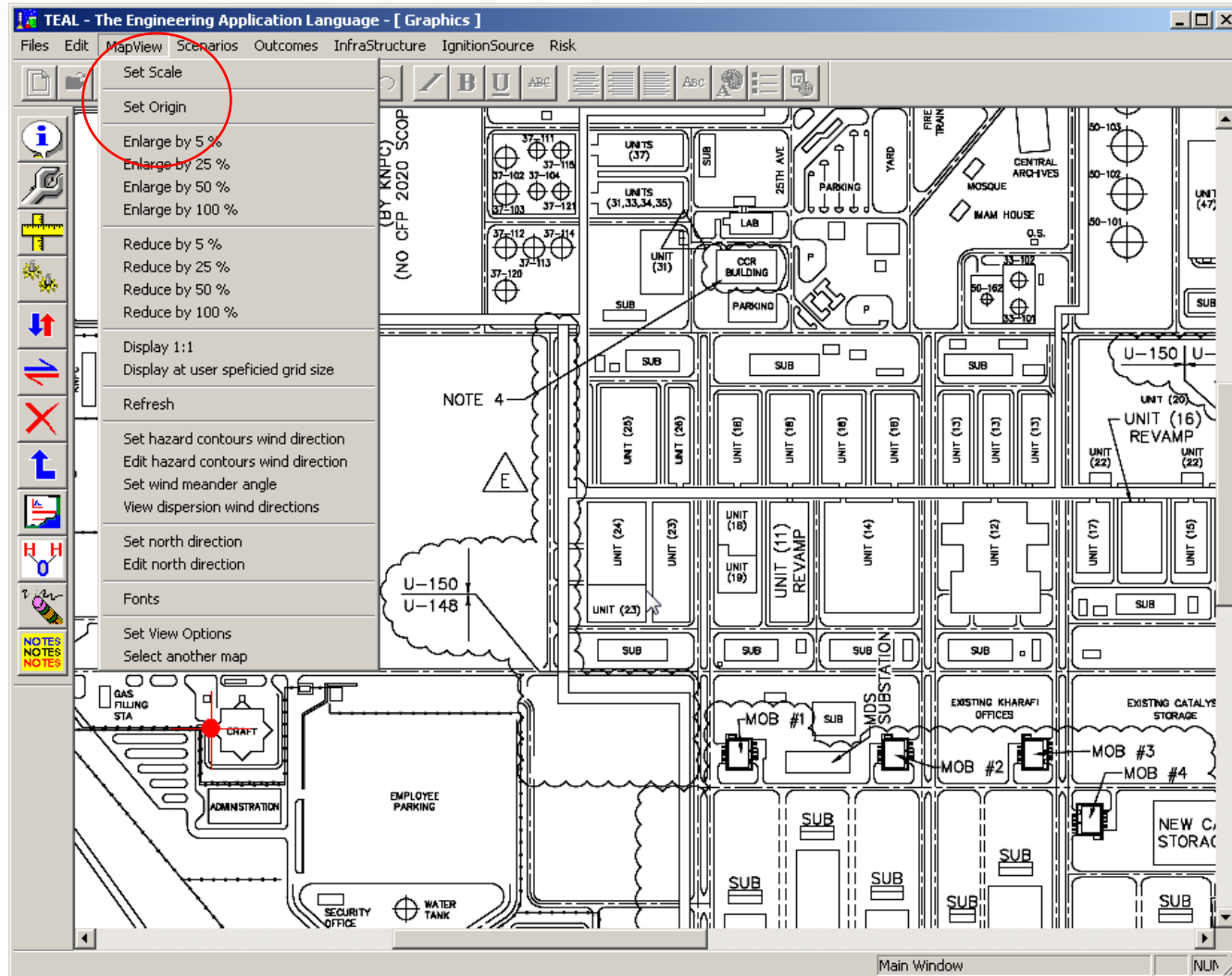
Source: Process Safety Office® SuperChems™

Two maps (to scale) are required for onsite and offsite risk estimates



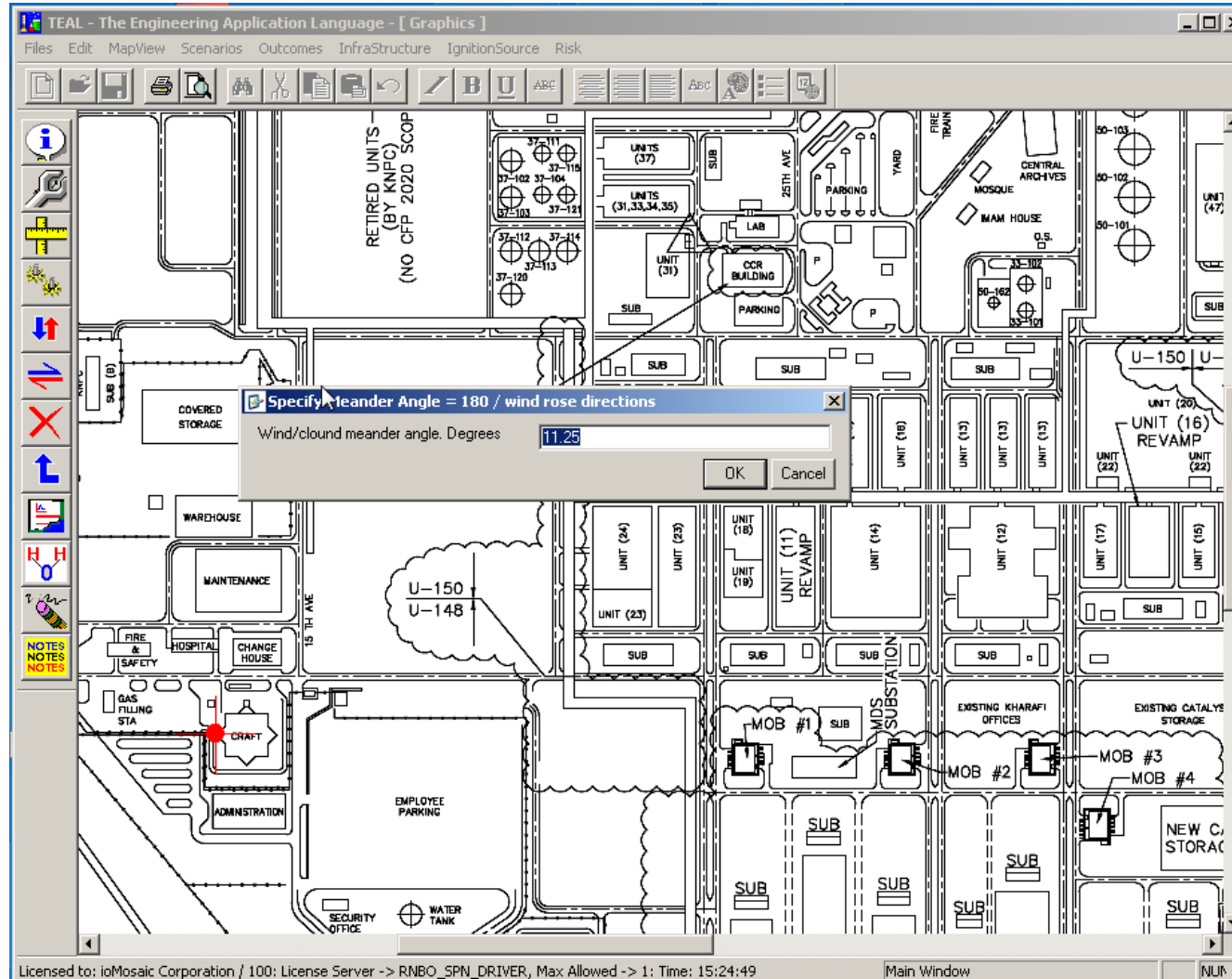
Source: Process Safety Office® SuperChems™

Once a map is associated with a site, scale the map, locate the origin and map North



Source: Process Safety Office® SuperChem™

Always set the wind meander angle to 180 over the wind rose number of wind directions



Source: Process Safety Office® SuperChems™

The QRA estimates are always calculated at the user defined grid size

The screenshot displays the TEAL software interface. The title bar reads 'TEAL - The Engineering Application Language - [Graphics]'. The menu bar includes 'Files', 'Edit', 'MapView', 'Scenarios', 'Outcomes', 'InfraStructure', 'IgnitionSource', and 'Risk'. The toolbar contains icons for various operations like zooming and editing. On the left, there is a vertical toolbar with icons for information, zoom, pan, and other navigation tools. Below the toolbar is a property panel with the following settings:

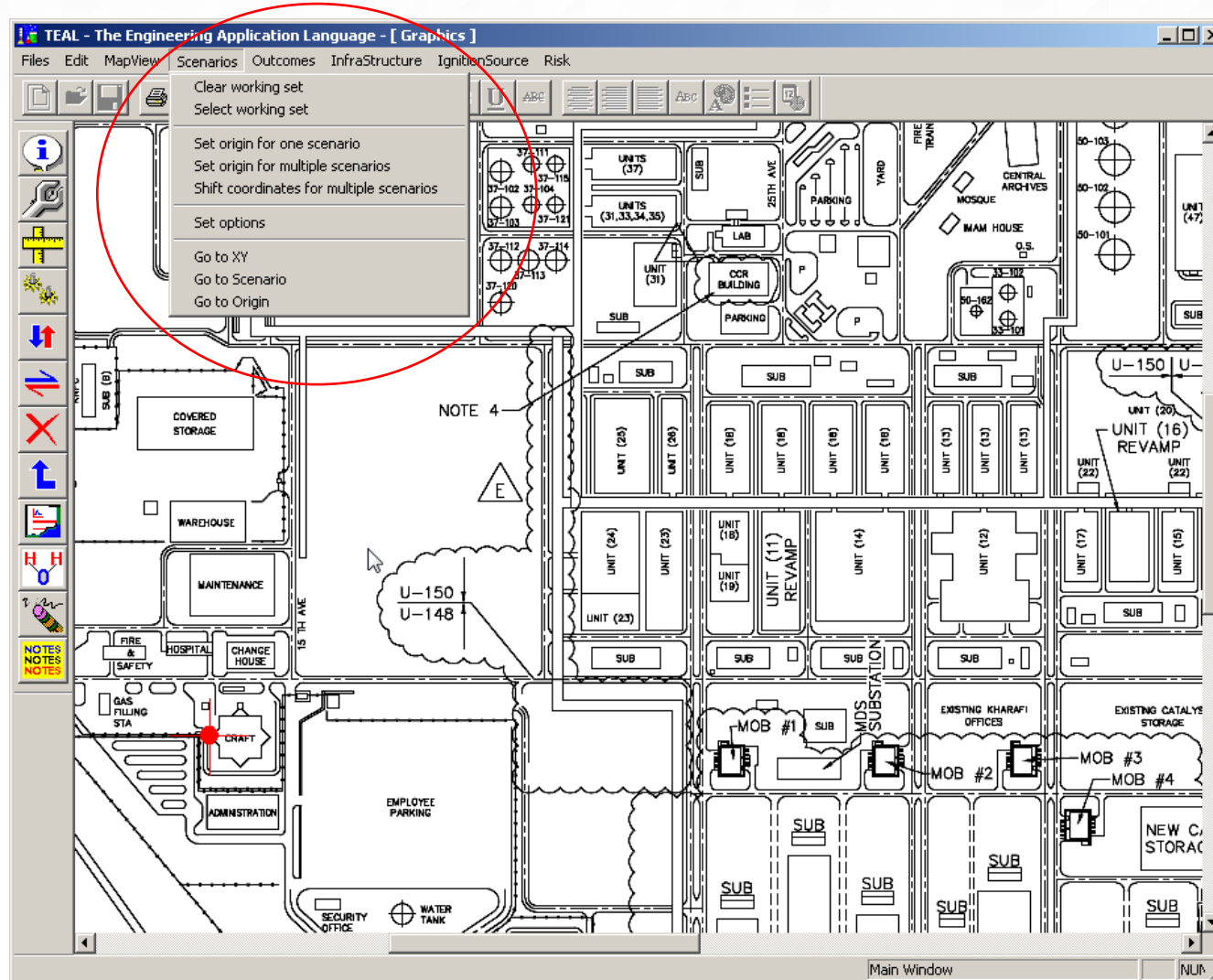
- Set Scale
- Set Origin
- Enlarge by 5 %
- Enlarge by 25 %
- Enlarge by 50 %
- Enlarge by 100 %
- Reduce by 5 %
- Reduce by 25 %
- Reduce by 50 %
- Reduce by 100 %
- Display 1:1**
- Display at user specified grid size**
- Refresh
- Set hazard contours wind direction
- Edit hazard contours wind direction
- Set wind meander angle
- View dispersion wind directions
- Set north direction
- Edit north direction
- Fonts
- Set View Options
- Select another map

The main window shows a detailed process flow diagram. Key elements include:

- Units (e.g., UNIT (37), UNIT (31), UNIT (23), UNIT (18), UNIT (11) REVAMP, UNIT (12), UNIT (17), UNIT (19), UNIT (16) REVAMP, UNIT (22), UNIT (20))
- Substations (SUB)
- Mobility units (MOB #1, MOB #2, MOB #3, MOB #4)
- Other facilities: LAB, CCR BUILDING, PARKING, YARD, FIRE TRUNK, MOSQUE, MAM HOUSE, O.S., CENTRAL ARCHIVES, EXISTING KHWARFI OFFICES, EXISTING CATALYTIC STORAGE, NEW CATALYTIC STORAGE, SECURITY OFFICE, WATER TANK, EMPLOYEE PARKING, ADMINISTRATION, GAS FILLING STA, CRAFT.
- Grid lines and labels: U-150, U-148, U-100, U-101, U-102, U-103.
- Notes: NOTE 4, (BY KNPC) (NO CFP 2020 SCOP).

Source: Process Safety Office® SuperChems™

Select your scenarios, locate on the map, generate the outcomes, and then select for analysis



Source: Process Safety Office® SuperChem™

Use the scenario options to select specific hazard estimates

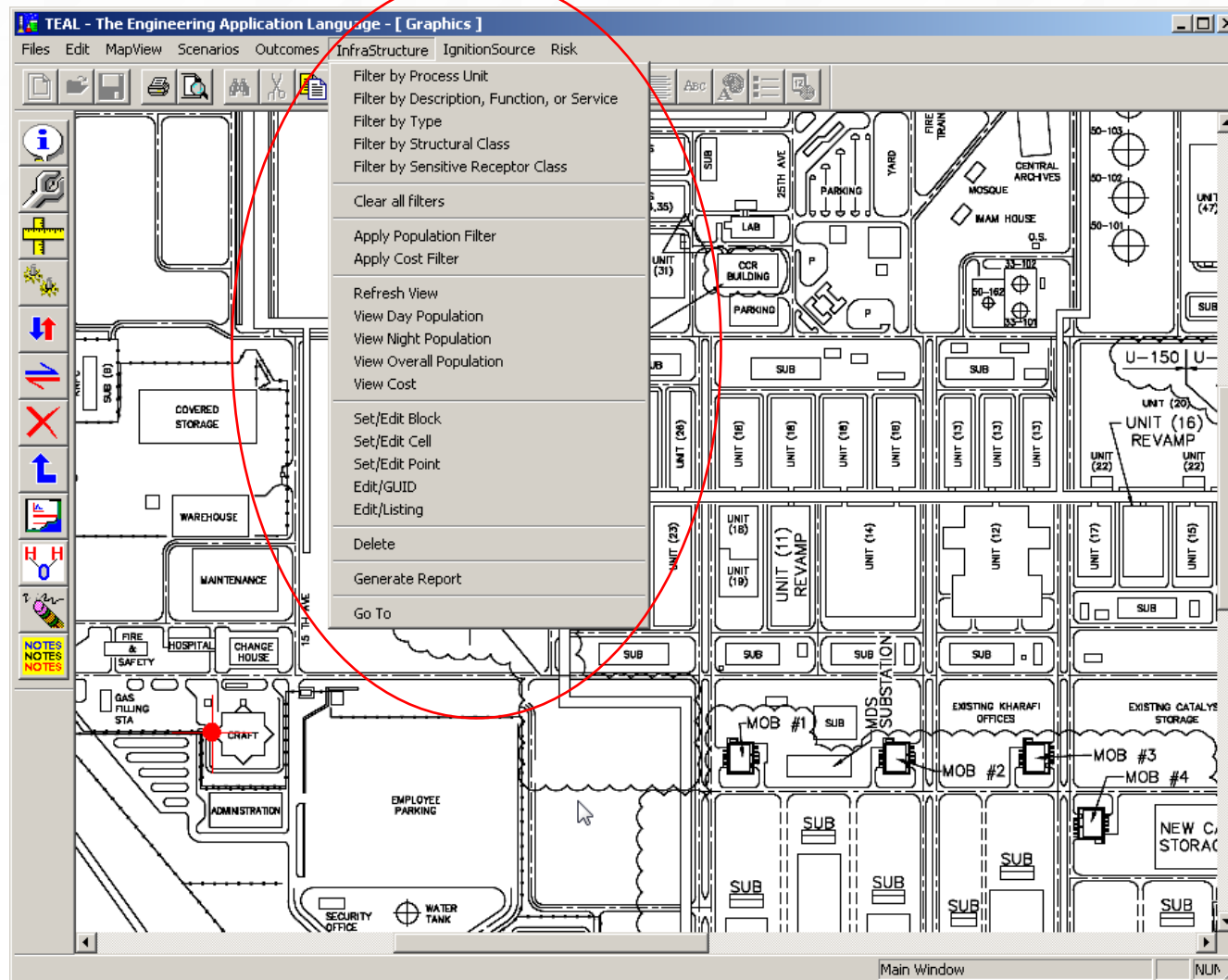
The screenshot displays the TEAL software interface with a facility layout. Two dialog boxes are open:

- Select Scenario Selection Options**:
 - Select from scenarios associated with site: MAB-F only
 - Apply user defined scenario filter: * and key 0
 - Use fixed injury, fatality, or damage criteria instead of probits
- Enter Numeric Value. Leave as blank or enter 0 to ignore fixed damage**:

Overpressure Limit. bara	0.206842774349667
Probability of injury, fatality, or damage due to overpressure	1.
Thermal Radiation Flux Limit. W/m2	12500.
Probability of injury, fatality, or damage due to thermal radiation flux	1.
Thermal Radiation Dose Limit. J/m2	160000.
Probability of injury, fatality, or damage due to thermal radiation dose	1.
Toxicity Concentration Limit. PPM	1000.
Probability of injury or fatality due to toxicity exposure to a fixed dosage	1.
Toxicity Dosage Limit. PPM-MIN	
Probability of injury or fatality due to toxicity exposure to a fixed concentration	

Source: Process Safety Office® SuperChems™

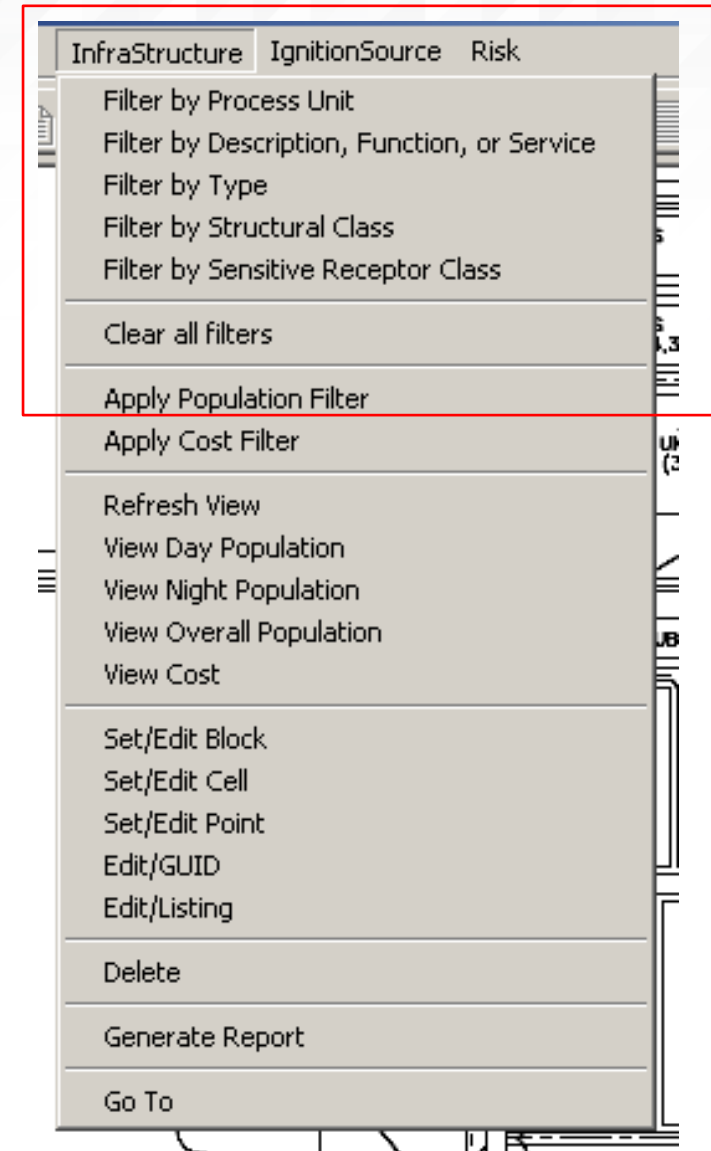
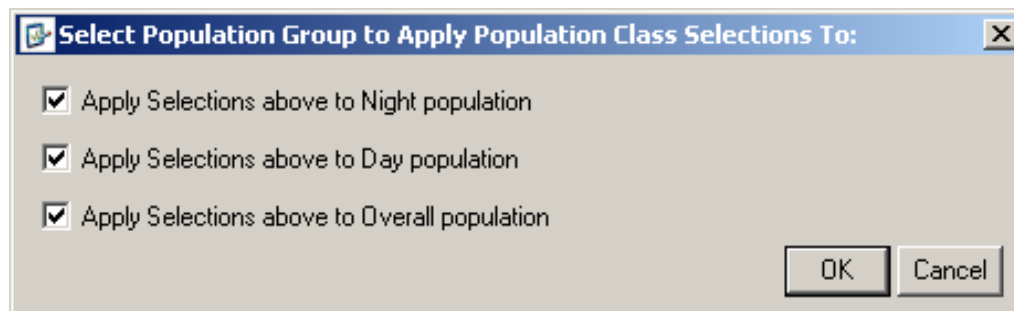
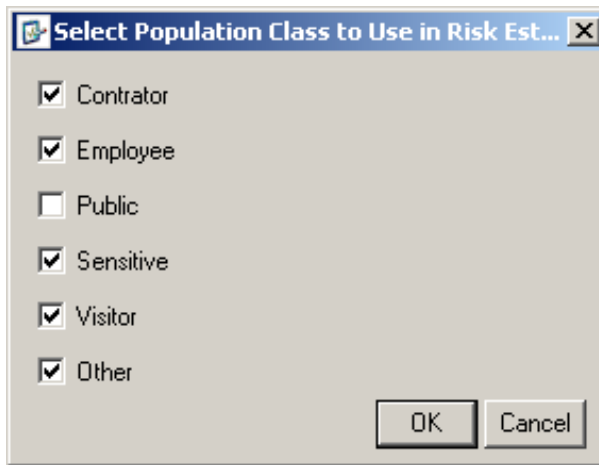
Define infrastructure blocks to specify building types and population



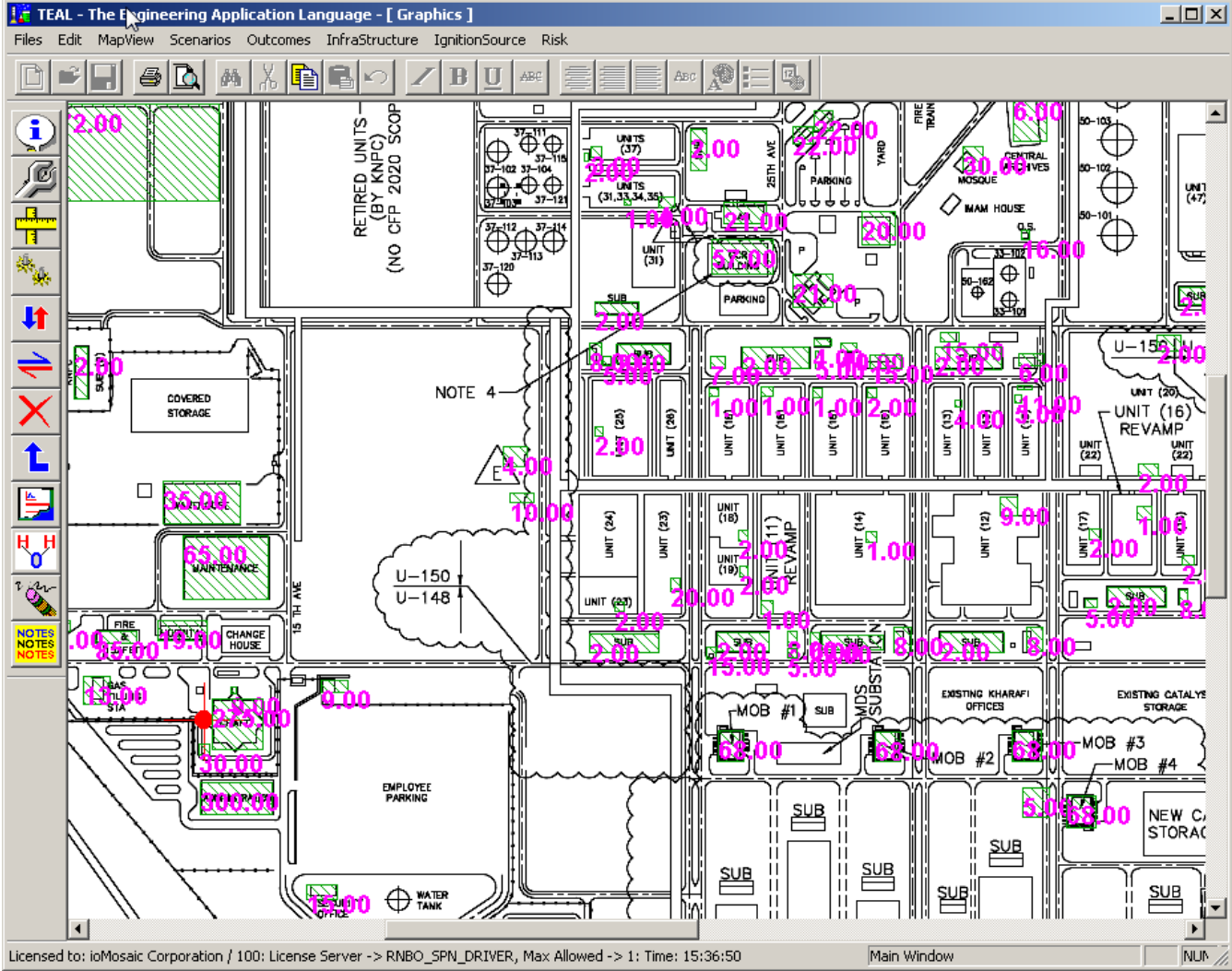
Source: Process Safety Office® SuperChems™

The infrastructure objects are versatile

- Filter day, night, or overall population
- Filter by onsite or offsite



Always check the population count and building type visually and by running a report



Source: Process Safety Office® SuperChem™

Specify the correct infrastructure data as a block or point source

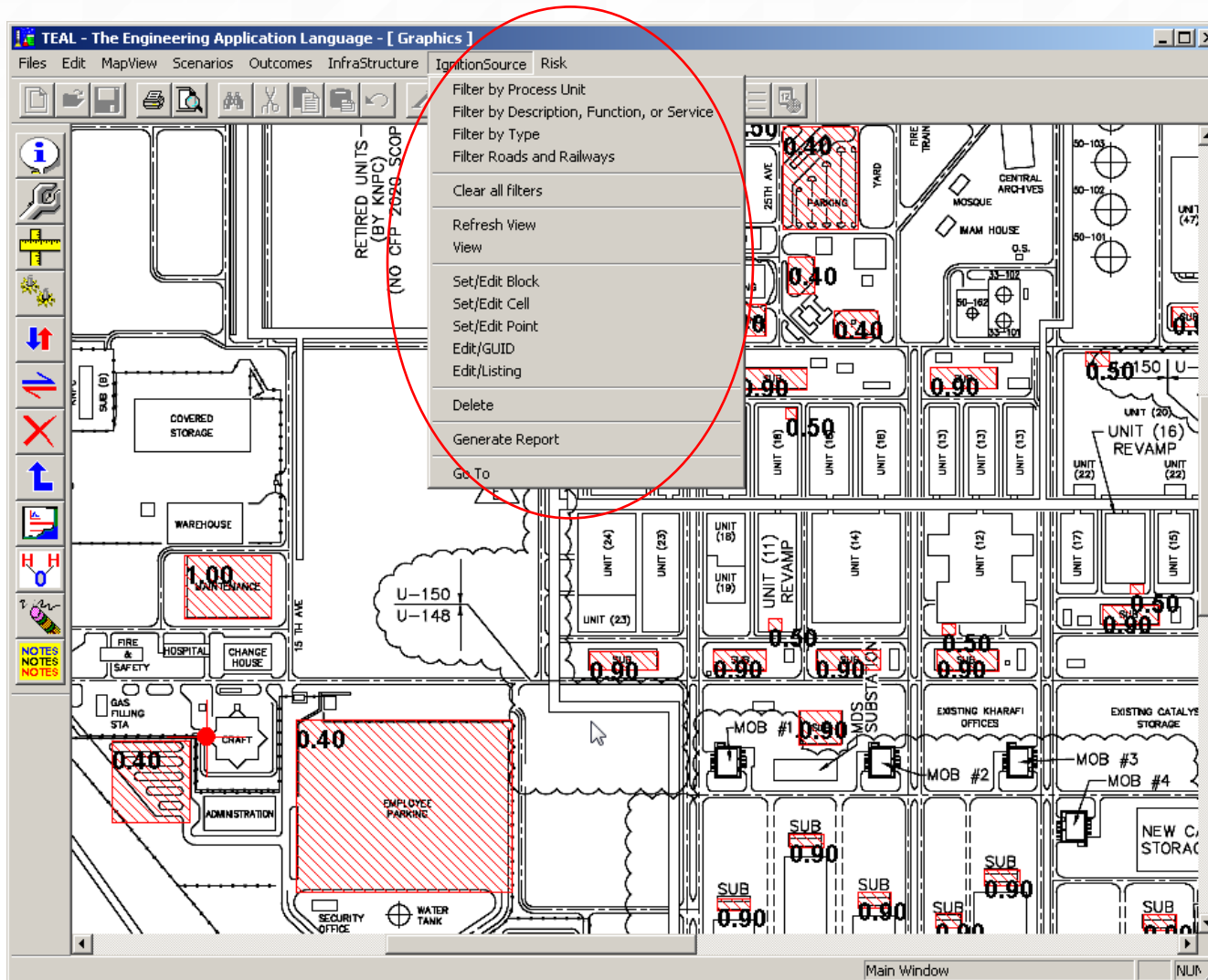
MAB-F

	A	B	C	D	E	F
1	InfraStructure GUID	8FCCAF49-D2B9-11DC-AC2D-001DD9E780C5				
2	Map File	C:\P8\..... FINAL REPORT DATA\..... .BMP				
3						
4	X1 Coordinate. m	-30.637	Area. m2	11551.902		
5	Y1 Coordinate. m	173.611				
6	X2 Coordinate. m	92.763				
7	Y2 Coordinate. m	267.224				
8						
9	InfraStructure Location or Unit	<input type="text"/>				
10	InfraStructure Description, Function, or Service	Engineering and Maintenance Building				
11	InfraStructure Type	Building - Maintenance Area or Shed <<< Press F12 for list				
12	InfraStructure Structural Class	CCPS-D <<< Press F12 for list				
13						
14	<input type="checkbox"/> InfraStructure is a sensitive receptor					
15						
16	InfraStructure Building Characteristics [If Applicable]					
17						
18	<input type="checkbox"/> Flammable or toxic detectors will automatically shutdown air handling s					
19	<input type="checkbox"/> InfrStructure administration can shutdown the air handling system					
20	<input type="checkbox"/> InfraStructure operates under positive pressure					
21						
22	Number of toxic detectors	0				
23	Number of flammable detectors	0				
24	Fraction of InfraStructure surface covered by windows	0.250				
25						
26	InfraStructure Population Statistics [If Applicable]					
27						
28	Overall Population	Number	Presence Factor	Include in Risk Estimates		
29	Contractor	20	1	<input checked="" type="checkbox"/> Yes		
30	Employee	40	1	<input checked="" type="checkbox"/> Yes		
31	Public	0	1	<input type="checkbox"/> Yes		
32	Sensitive	0	1	<input checked="" type="checkbox"/> Yes		
33	Visitor	5	1	<input checked="" type="checkbox"/> Yes		
34	Other	0	1	<input checked="" type="checkbox"/> Yes		
35						
36	Fraction Present Outdoor	0.075				

Update Help Print Save As Cut Copy Paste Cancel OK

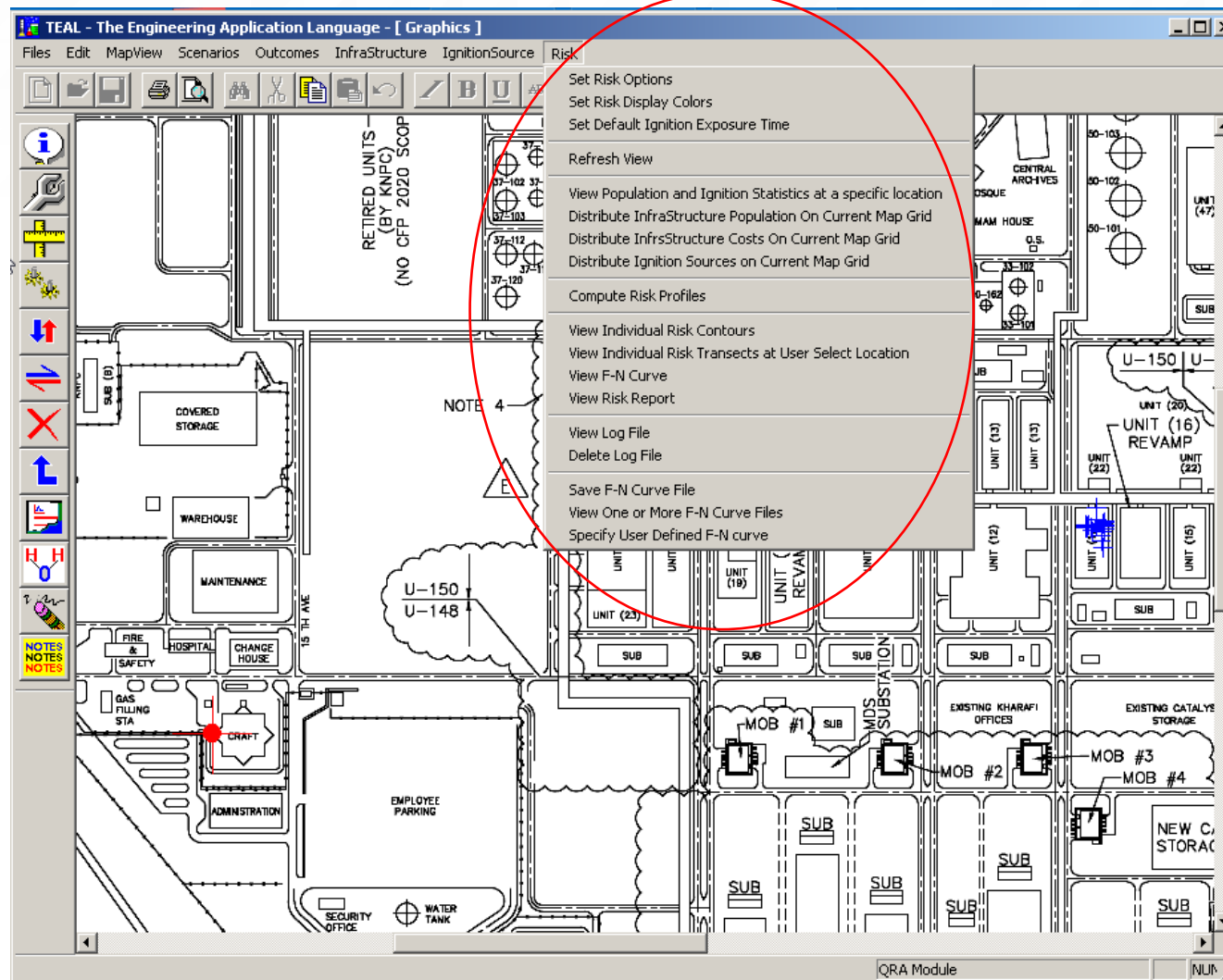
Source: Process Safety Office® SuperChems™

Repeat the same exercise for ignition sources



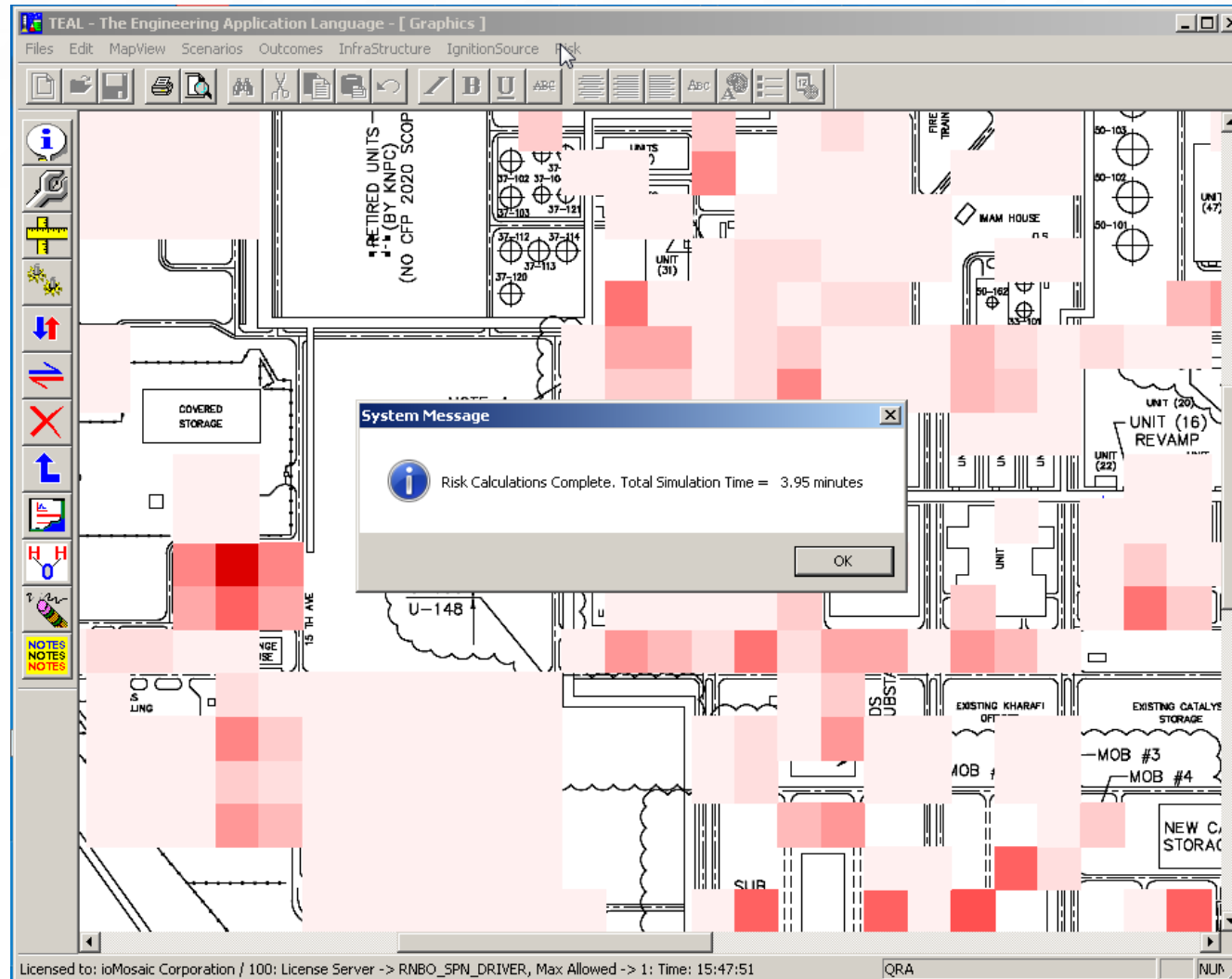
Source: Process Safety Office® SuperChemicals™

Set your risk options and execute the QRA



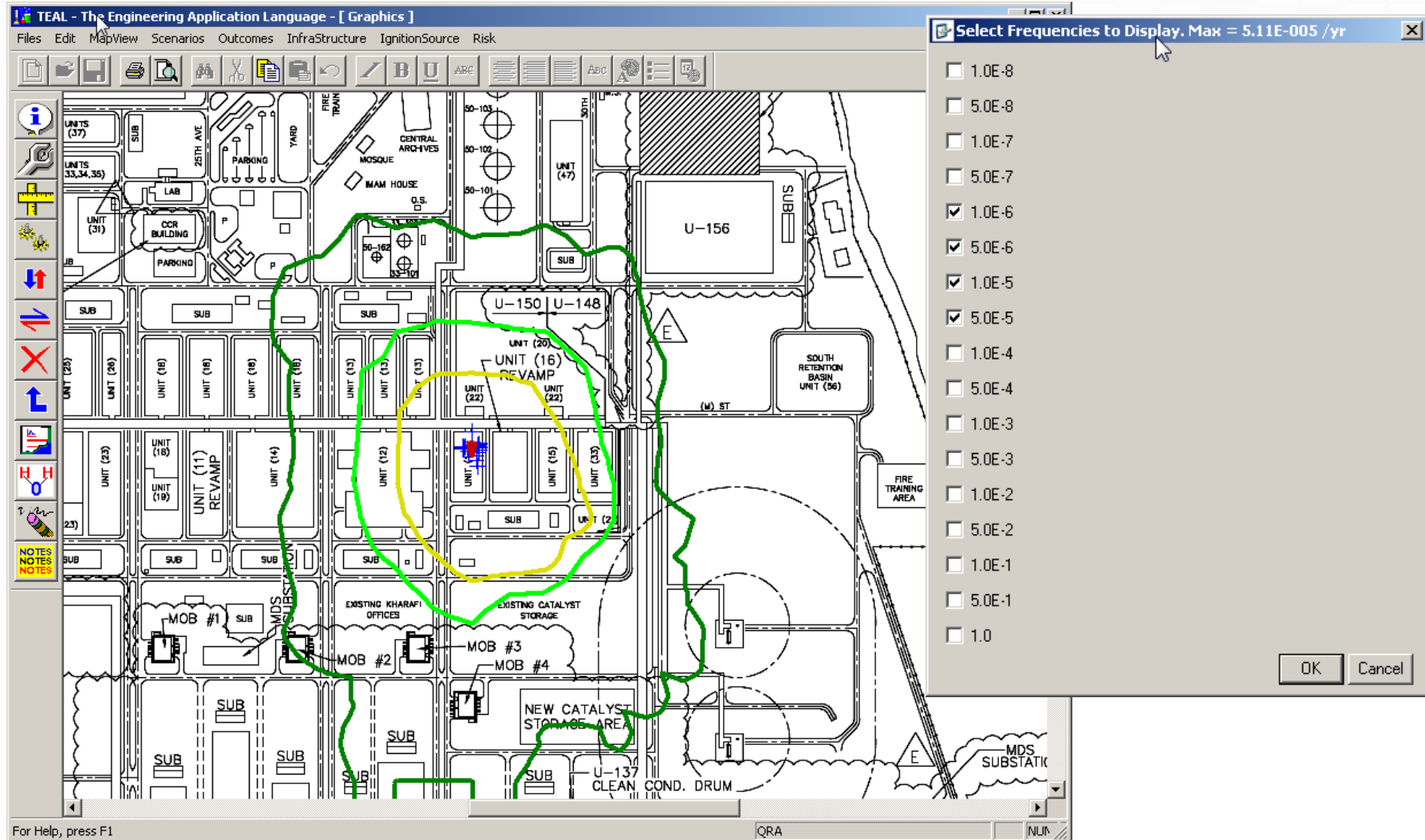
Source: Process Safety Office® SuperChems™

Display the individual risk contours or risk transects at specific locations



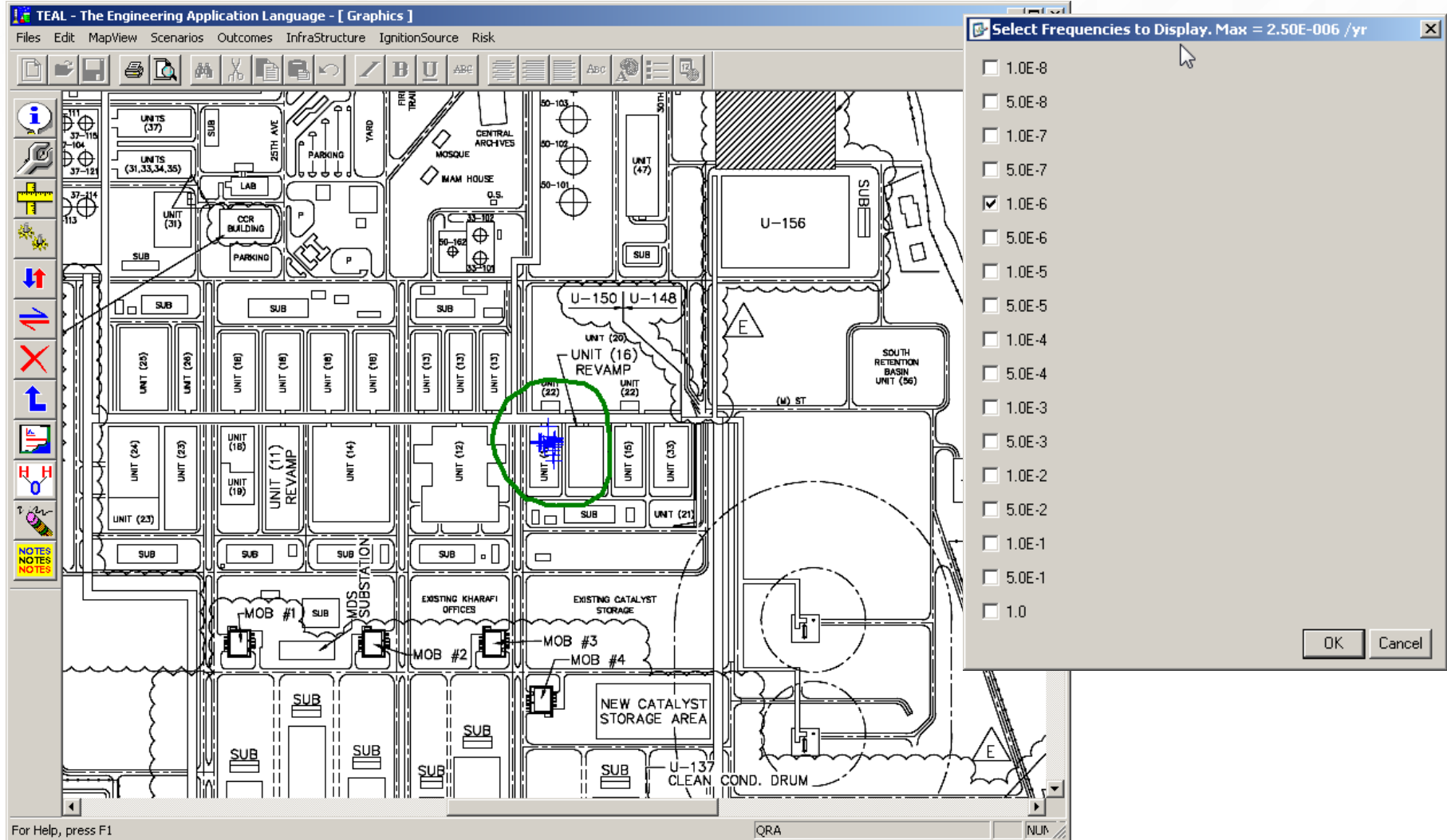
Source: Process Safety Office® SuperChems™

Display Individual Risk Contours



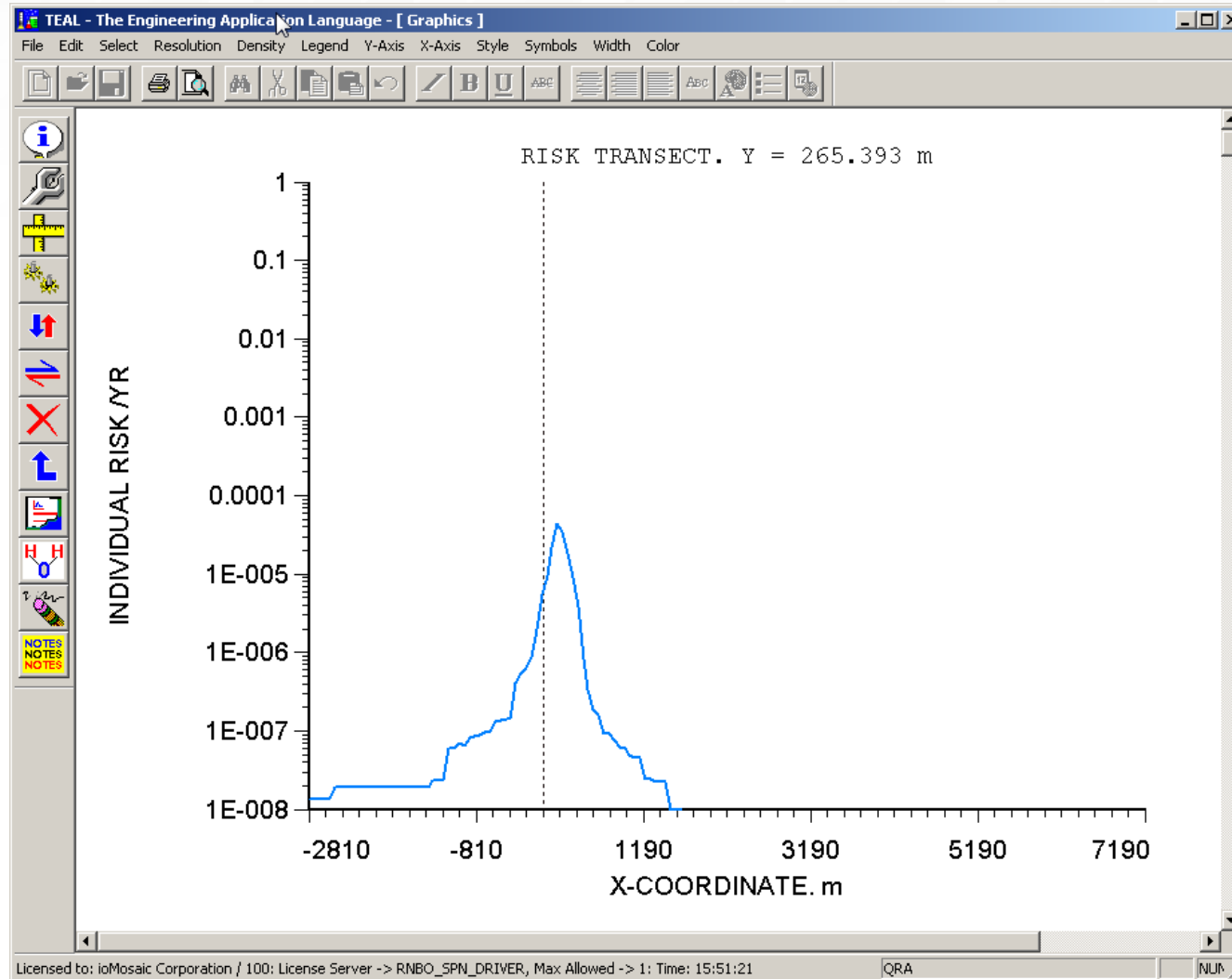
Source: Process Safety Office® SuperChems™

Display Overpressure Risk – 3 psi



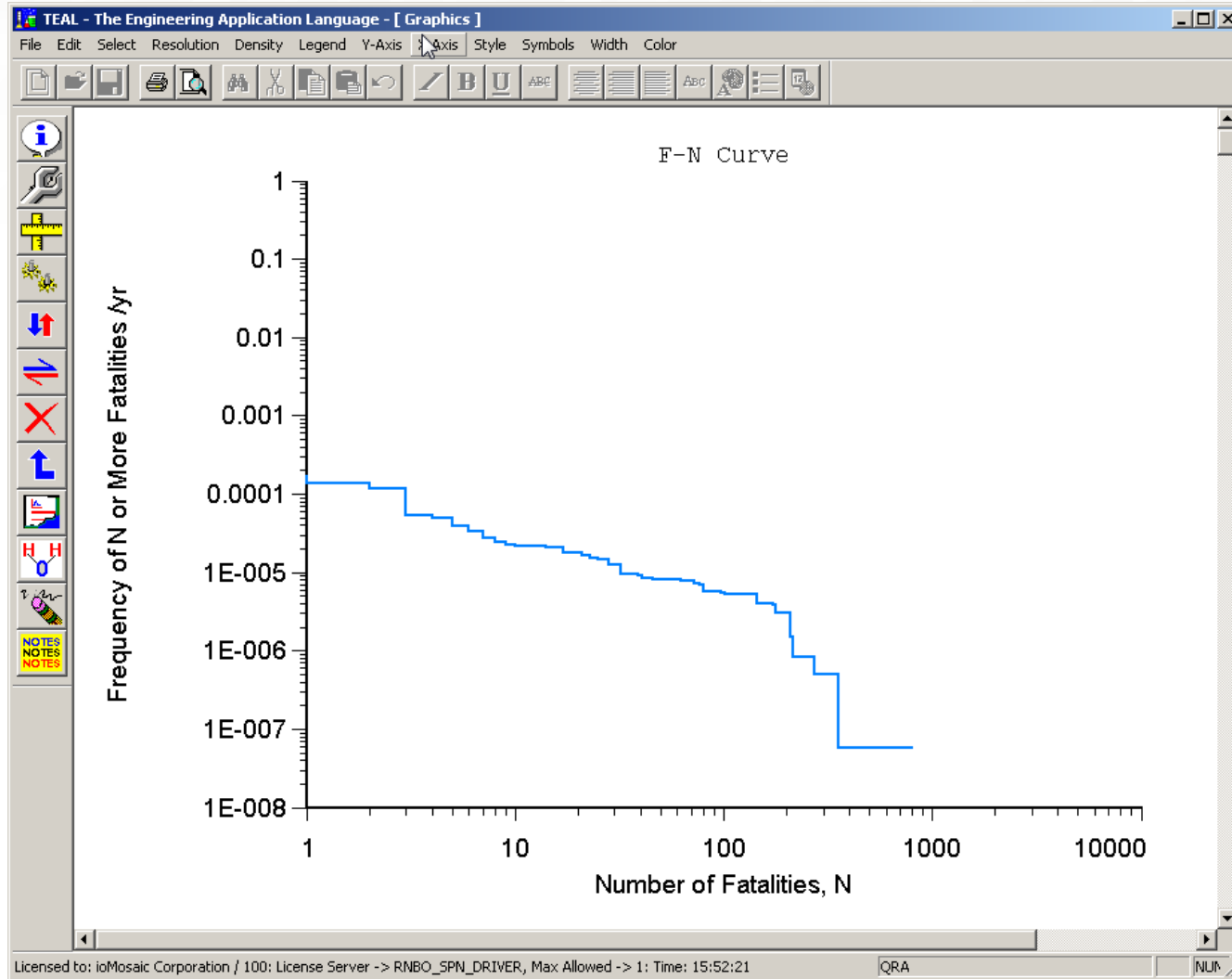
Source: Process Safety Office® SuperChems™

Display Risk Transects



Source: Process Safety Office® SuperChems™

Display Societal Risk



Source: Process Safety Office® SuperChems™

Generate Risk Reports

Risk Report										
Outcomes Summary Risk Indicators										
	C	D	E	F	G	H	I	J	K	
1	Parent Event Frequency, /yr	Outcome Frequency, /yr	N	F-N	Model Key	Site	Stability Class	Wind Speed, m/s	Stability Class Probability	
2	1.4000E-05	6.5693E-07	214.44	1.4087E-04	GPUFF-T	MAB-F	F	1.90	0.07	
3	1.7861E-05	8.5158E-07	207.46	1.7667E-04	GPUFF-T	MAB-F	F	1.90	0.07	
4	7.7508E-06	3.4566E-07	353.67	1.2225E-04	GPUFF-T	MAB-F	F	1.90	0.07	
5	3.2790E-05	1.1823E-06	159.18	1.8820E-04	VCFIRE	MAB-F	F	1.90	0.07	
6	1.3396E-05	3.0650E-06	36.71	1.1251E-04	VCFIRE	MAB-D	D	4.92	0.70	
7										

Source: Process Safety Office® SuperChems™

Sort buildings and infrastructure by risk level (overall, thermal, overpressure, and / or toxicity)

	A	C	D	E	F	G	H	I	
1	GUID	Description, Function, or Service	Type	Structural Class	Sensitive Receptor	Risk Frequency /yr	X1. m	Y1. m	
2	E1A8ECCC-EC59-11DC-BAED-00151740847B	Operator Shelter	Building - Operator Shelter	CCPS-E	No	4.866E-05	1270.81	258.37	12
3	35FB9FFC-EC5B-11DC-BAED-00151740847B	Contractor Shelter	Building - Contractor Shelter	CCPS-B	No	2.502E-05	1257.42	185.65	12
4	AB0770F3-EC59-11DC-BAED-00151740847B	Operator Shelter	Building - Operator Shelter	CCPS-E	No	2.219E-05	1340.67	288.04	12
5	6AF1F792-EC5B-11DC-BAED-00151740847B	Maintenance Shelter #4	Building - Maintenance Shelter	CCPS-B	No	1.782E-05	1266.03	161.72	12
6	7CBFB0B1-EC59-11DC-BAED-00151740847B	Building - SS-B-212	Building - SS-B-212	CCPS-E	No	1.711E-05	1297.61	161.72	12
7	53EE0692-EC59-11DC-BAED-00151740847B	Operator Shelter	Building - Operator Shelter	CCPS-E	No	1.477E-05	1404.78	222.01	14
8	D9F2A40A-D2A5-11DC-B566-001438EB97DD	Local Control Room 3	Building - Control Room	CCPS-E	No	1.380E-05	1401.00	166.00	14
9	A443694E-EC58-11DC-BAED-00151740847B	Operator Shelter	Building - Operator Shelter	CCPS-A	No	1.243E-05	1342.58	350.24	12
10	411B74A0-EC57-11DC-BAED-00151740847B	Operator Shelter	Building - Operator Shelter	CCPS-E	No	9.756E-06	1144.50	292.82	12
11	13470652-D2A5-11DC-B566-001438EB97DD	Local Control Room 1	Building - Control Room	CCPS-E	No	8.784E-06	1181.23	97.87	12
12	6345CDB1-DDC2-11DC-92D9-001DD9E780C5	Building - Maintenance Shelter	Building - Maintenance Shelter	CCPS-B	No	5.620E-06	1164.59	455.50	12
13	36960681-DDC3-11DC-92D9-001DD9E780C5	Building - Maintenance Shelter	Building - Maintenance Shelter	CCPS-B	No	4.823E-06	1169.38	474.64	12
14	BF878867-EC57-11DC-BAED-00151740847B	Building - SS-B-127	Building - SS-B-127	CCPS-E	No	4.143E-06	1057.42	95.69	12
15	7C558E21-DDC3-11DC-92D9-001DD9E780C5	Building - SS-B-122	Building - SS-B-122	CCPS-E	No	3.668E-06	1050.72	503.35	12
16	119D9D90-D2A6-11DC-B566-001438EB97DD	Local Control Room 2	Building - Control Room	CCPS-E	No	3.231E-06	1170.17	509.77	12
17	CD9157F7-EC58-11DC-BAED-00151740847B	Operator Shelter	Building - Operator Shelter	CCPS-E	No	3.111E-06	1369.38	530.14	14
18	B9840DF1-DDB7-11DC-92D9-001DD9E780C5	Building - MOB #3	Building - MOB #3	CCPS-C	No	2.817E-06	1161.72	-59.33	12
19	AA7D59E1-DDC3-11DC-92D9-001DD9E780C5	Building - Operator Shelter	Building - Operator Shelter	CCPS-E	No	2.749E-06	1079.43	448.80	10
20	CEA5E7D1-DDB7-11DC-92D9-001DD9E780C5	Building - MOB #4	Building - MOB #4	CCPS-C	No	1.780E-06	1239.23	-155.02	12
21	6AC3B42E-D2A8-11DC-B566-001438EB97DD	Central Tool Room	Building - Central Tool Room	CCPS-B	No	1.686E-06	1176.13	-139.57	12
22	D0D4D854-D2A4-11DC-B566-001438EB97DD	Local Control Room 6	Building - Control Room	CCPS-E	No	1.525E-06	991.45	96.17	10
23	26B50503-EC61-11DC-BAED-00151740847B	Contractor Shelter	Building - Contractor Shelter	CCPS-B	No	1.424E-06	1058.37	543.54	10
24	0B736B65-EC5D-11DC-BAED-00151740847B	Building - SS-B-223	Building - SS-B-223	CCPS-E	No	1.221E-06	1401.91	596.17	14
25	59569A1C-D2A5-11DC-B566-001438EB97DD	Local Control Room 5	Building - Control Room	CCPS-E	No	1.202E-06	956.56	505.51	10

Source: Process Safety Office® SuperChems™

About ioMosaic Corporation

Through innovation and dedication to continual improvement, ioMosaic has become a leading provider of integrated process safety and risk management solutions. ioMosaic has expertise in a wide variety of areas, including pressure relief systems design, process safety management, expert litigation support, laboratory services, training, and software development.

ioMosaic offers integrated process safety and risk management services to help you manage and reduce episodic risk. Because when safety, efficiency, and compliance are improved, you can sleep better at night. Our extensive expertise allows us the flexibility, resources, and capabilities to determine what you need to reduce and manage episodic risk, maintain compliance, and prevent injuries and catastrophic incidents.

Our mission is to help you protect your people, plant, stakeholder value, and our planet.

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