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# Process Safety Office® SuperChems™ Facility Siting Module Quick Tutorial

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QMS_7.3_7.4.F06 Rev.8

# The QRA / Facility Siting module of SuperChems™ features many useful tools for building overpressure modeling and reporting

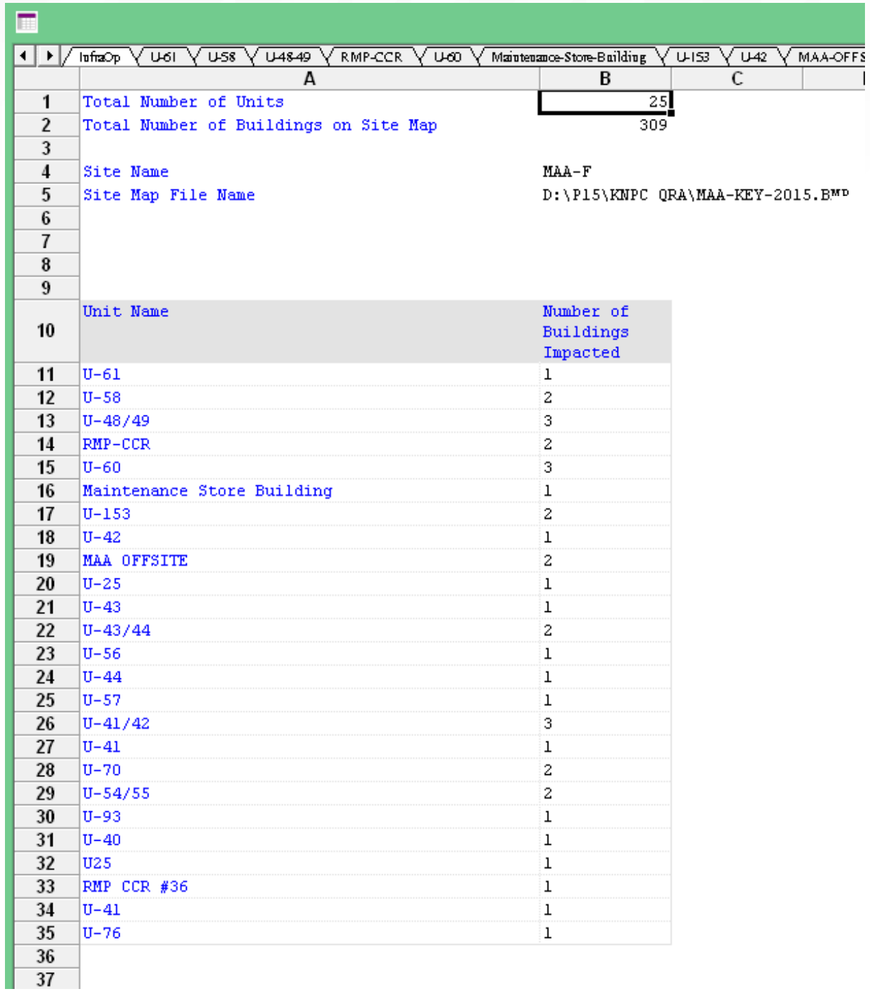
- A tool for overpressure data reduction and reporting
- Once the overpressure data reduction tool is executed, detailed building overpressure plots and statistics can be generated
- Overpressure contours with contributions from multiple scenarios with multiple outcomes and from multiple project files can be overlaid on the plot plan


Source: Process Safety Office® SuperChems™ - ioMosaic Corporation

# The overpressure data reduction tool can be run after the QRA is executed first

- The tool will consider all overpressure outcomes from explosions and vessel failures (immediate and delayed ignition)
- The frequencies of outcomes producing a specific level of overpressure are added for all outcomes reaching a specific building
- A Table is generated for each building showing the cumulative frequencies of all outcomes producing a specific level of overpressure along with impulse and positive phase duration
- Data from multiple projects can be consolidated once the tool is executed for each of the project files first separately. This is independent of the plot plan map resolution

# The primary results of the overpressure data reduction tool are displayed as multiple tables in one workbook



InfraOp | U-61 | U-58 | U-48-49 | RMP-CCR | U-60 | Maintenance-Store-Building | U-153 | U-42 | MAA-OFFS

| | A | B | C |
|---|---|---|---|
| 1 | Total Number of Units | 25 | |
| 2 | Total Number of Buildings on Site Map | 309 | |
| 3 | | | |
| 4 | Site Name | MAA-F | |
| 5 | Site Map File Name | D:\P15\KNPC QRA\MAA-KEY-2015.BMD | |
| 6 | | | |
| 7 | | | |
| 8 | | | |
| 9 | | | |
| 10 | Unit Name | Number of Buildings Impacted | |
| 11 | U-61 | 1 | |
| 12 | U-58 | 2 | |
| 13 | U-48/49 | 3 | |
| 14 | RMP-CCR | 2 | |
| 15 | U-60 | 3 | |
| 16 | Maintenance Store Building | 1 | |
| 17 | U-153 | 2 | |
| 18 | U-42 | 1 | |
| 19 | MAA OFFSITE | 2 | |
| 20 | U-25 | 1 | |
| 21 | U-43 | 1 | |
| 22 | U-43/44 | 2 | |
| 23 | U-56 | 1 | |
| 24 | U-44 | 1 | |
| 25 | U-57 | 1 | |
| 26 | U-41/42 | 3 | |
| 27 | U-41 | 1 | |
| 28 | U-70 | 2 | |
| 29 | U-54/55 | 2 | |
| 30 | U-93 | 1 | |
| 31 | U-40 | 1 | |
| 32 | U25 | 1 | |
| 33 | RMP CCR #36 | 1 | |
| 34 | U-41 | 1 | |
| 35 | U-76 | 1 | |
| 36 | | | |
| 37 | | | |

- The first sheet displays the overall statistics
- It reports the number of buildings impacted in each process unit associated with the plot plan map as defined by the user

Source: Process Safety Office® SuperChems™ - ioMosaic Corporation

# The primary results of the overpressure data reduction tool are displayed as multiple tables in one workbook

Infrastructure Overpressure Analysis Report

InfraOp | U-61 | U-58 | U-48-49 | RMP-CCR | U-60 | Maintenance-Store-Building | U-153 | U-42 | MAA-OFFSITE | U-25 | U-43 | U-43-44 | U-56 | U-44 | U-57 | U-41-42 | U-41- | U

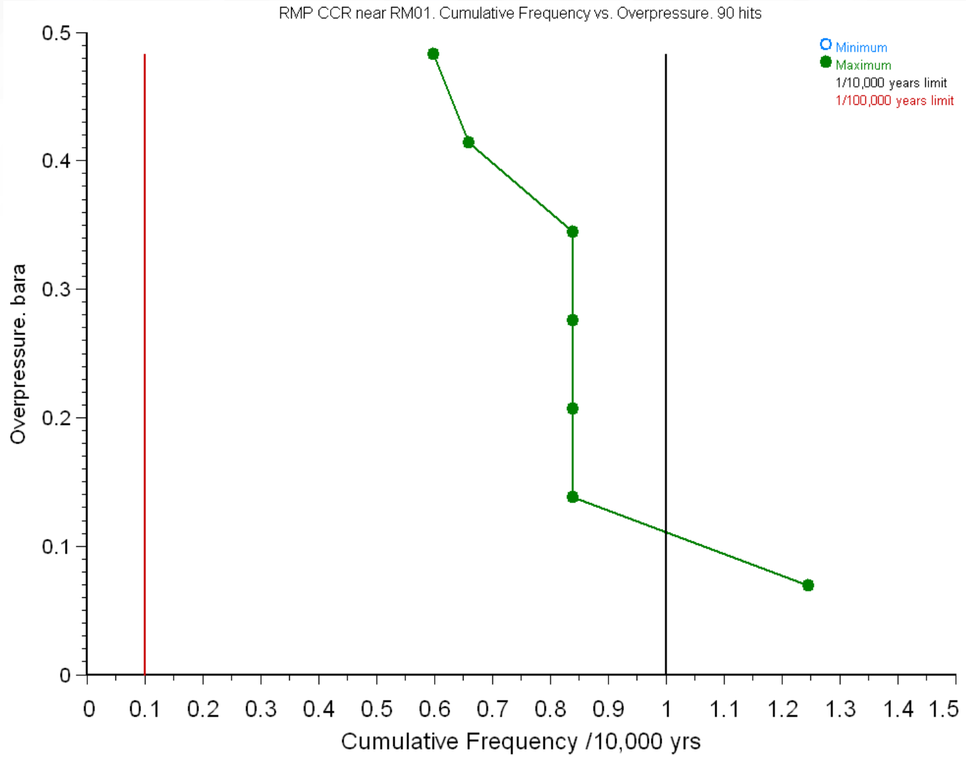
| | A | B | C | D | E | F | G | H |
|---|---|---|---|---|---|---|---|---|
| 1 | GUID | | 16162755-C273-11E4-9768-B8763FAD8395 | | | | | |
| 2 | Description | | Operator Shelter HP 4RMP | | | | | |
| 3 | Type | | Building - Operator Shelter | | | | | |
| 4 | Class | | CCPS-C | | | | | |
| 5 | Process Unit | | U-48/49 | | | | | |
| 6 | | | | | | | | |
| 7 | Overpressure | Overpressure | Duration | Duration | Impulse | Impulse | Frequency | Number of |
| 8 | min. bara | max. bara | min. ms | max. ms | min. bara.ms | max. bara.ms | (Cumulative)/yr | Outcomes |
| 9 | 0.07 | 0.07 | 10.28 | 126.08 | 0.355 | 4.347 | 8.7260E-05 | 48 |
| 10 | 0.14 | 0.14 | 16.50 | 113.86 | 1.137 | 7.851 | 2.6414E-05 | 33 |
| 11 | 0.21 | 0.21 | 24.91 | 40.20 | 2.576 | 4.157 | 4.7442E-07 | 14 |
| 12 | 0.28 | 0.28 | 43.19 | 43.19 | 5.955 | 5.955 | 9.1128E-10 | 2 |
| 13 | | | | | | | | |
| 14 | | | | | | | | |
| 15 | GUID | | 3EECA37C-C4EA-11E4-BC1B-B8763FAD8395 | | | | | |
| 16 | Description | | Operator Shelter HP/ARD 6FUP | | | | | |
| 17 | Type | | Building - Operator Shelter | | | | | |
| 18 | Class | | CCPS-E | | | | | |
| 19 | Process Unit | | U-48/49 | | | | | |
| 20 | | | | | | | | |
| 21 | Overpressure | Overpressure | Duration | Duration | Impulse | Impulse | Frequency | Number of |
| 22 | min. bara | max. bara | min. ms | max. ms | min. bara.ms | max. bara.ms | (Cumulative)/yr | Outcomes |
| 23 | 0.07 | 0.07 | 16.08 | 126.08 | 0.554 | 4.347 | 1.2443E-04 | 35 |
| 24 | 0.14 | 0.14 | 21.60 | 113.86 | 1.490 | 7.851 | 1.0199E-04 | 21 |
| 25 | 0.21 | 0.21 | 19.09 | 114.51 | 1.975 | 11.843 | 1.0199E-04 | 21 |
| 26 | 0.28 | 0.28 | 17.13 | 123.02 | 2.362 | 16.964 | 9.5993E-05 | 18 |
| 27 | 0.34 | 0.34 | 19.84 | 124.96 | 3.420 | 21.539 | 8.9994E-05 | 15 |
| 28 | 0.41 | 0.41 | 19.95 | 33.99 | 4.126 | 7.030 | 6.5995E-05 | 6 |
| 29 | 0.48 | 0.48 | 30.98 | 31.41 | 7.475 | 7.580 | 5.9996E-05 | 3 |
| 30 | 0.55 | 0.55 | 25.81 | 29.12 | 7.930 | 12.873 | 5.9996E-05 | 3 |
| 31 | 0.62 | 0.62 | 25.81 | 29.12 | 7.930 | 12.873 | 5.9996E-05 | 3 |
| 32 | 0.69 | 0.69 | 25.81 | 29.12 | 7.930 | 12.873 | 5.9996E-05 | 3 |
| 33 | | | | | | | | |
| 34 | | | | | | | | |
| 35 | GUID | | 90A3F2FE-C38C-11E4-955E-B8763FAD8395 | | | | | |
| 36 | Description | | Operator Shelter HP 5RMP | | | | | |
| 37 | Type | | Building - Operator Shelter | | | | | |
| 38 | Class | | CCPS-C | | | | | |
| 39 | Process Unit | | U-48/49 | | | | | |
| 40 | | | | | | | | |
| 41 | Overpressure | Overpressure | Duration | Duration | Impulse | Impulse | Frequency | Number of |
| 42 | min. bara | max. bara | min. ms | max. ms | min. bara.ms | max. bara.ms | (Cumulative)/yr | Outcomes |
| 43 | 0.07 | 0.07 | 22.54 | 126.08 | 0.777 | 4.347 | 2.6414E-05 | 33 |
| 44 | 0.14 | 0.14 | 34.95 | 39.97 | 2.409 | 2.756 | 4.0444E-09 | 4 |
| 45 | | | | | | | | |
| 46 | | | | | | | | |

- A sheet is generated for each process unit showing the statistics of all buildings impacted
- Since multiple outcomes from multiple scenarios can reach the same building, minimum and maximum values are reported
- This data is critical for detailed building structural analysis

Note that cumulative frequencies are only valid for a specific overpressure level. They are not additive for more than one overpressure level.

Source: Process Safety Office® SuperChems™ - ioMosaic Corporation

# Another key result produced is a graphical display of the previously shown data for each building

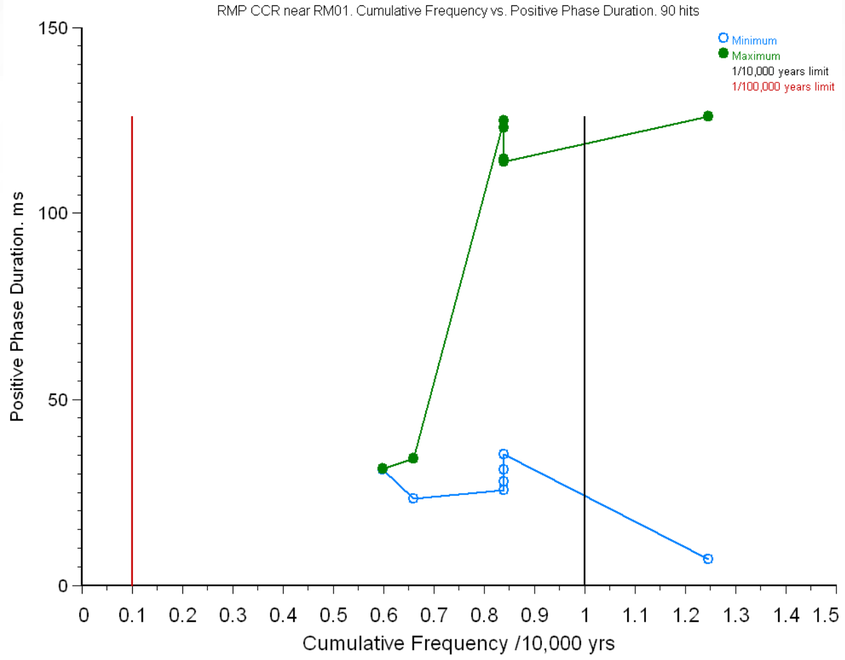



In this case above, the cumulative frequency of one or more outcomes exceeds 1/10,000 years

- This plot shows the cumulative frequency for each overpressure level and draws two limits at 1/10,000 years and 1/100,000 years
- It is typical to consider mitigation for scenarios that impact buildings at a frequency > 1/10,000 years

Source: Process Safety Office® SuperChems™ - ioMosaic Corporation

# Additional results include positive phase duration and impulse loadings for each building

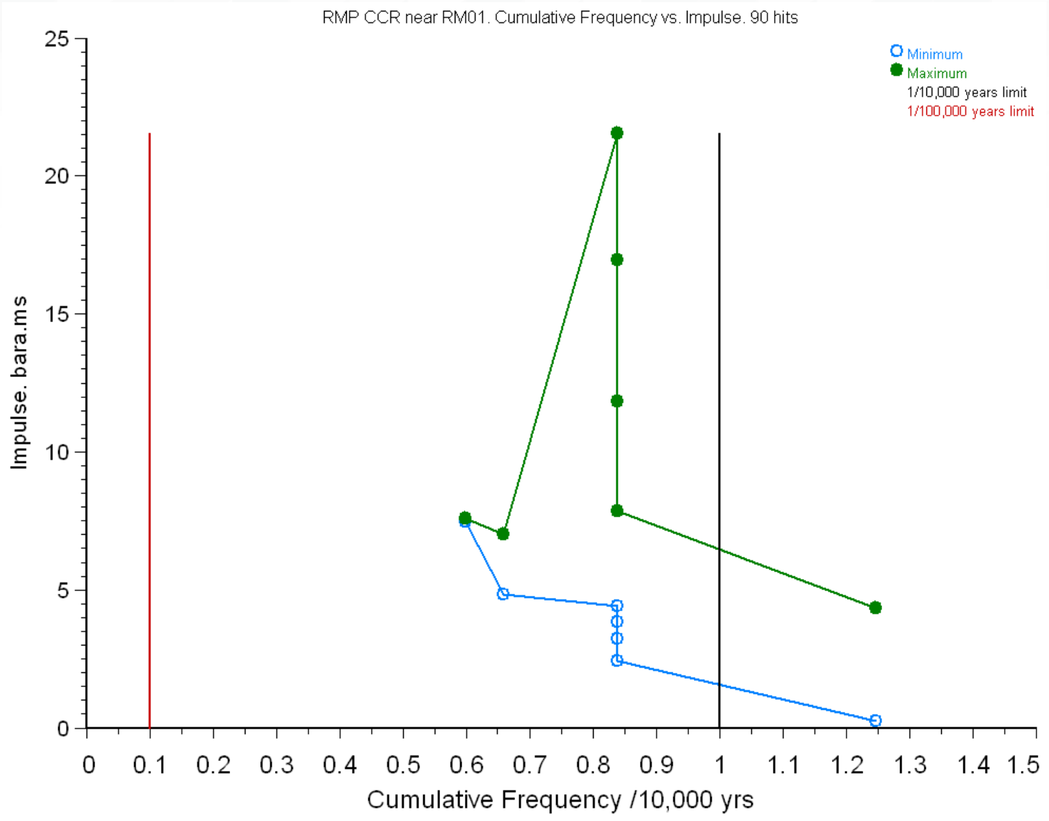



Typical positive phase durations for gas phase explosions range from 50 to 200 milliseconds. If your plots show higher values, examine the scenarios carefully. Large vapor cloud mass or low overpressure deflagrations can produce longer positive phase durations

- Note the upper line shows the maximum positive phase duration value associated with a specific overpressure level
- The lower line shows the minimum positive phase duration associated with a specific overpressure level
- This is due to the fact that multiple scenario outcomes can impact the same building

Source: Process Safety Office® SuperChems™ - ioMosaic Corporation

# Additional results include impulse loadings for each building




Examine the positive phase duration plots from the previous plots. Typical positive phase durations for gas explosion in petrochemical plants range from 50 to 200 milliseconds.

- Note the upper line shows the maximum impulse value associated with a specific overpressure level
- The lower line shows the minimum impulse value associated with a specific overpressure level
- This is due to the fact that multiple scenario outcomes can impact the same building

Source: Process Safety Office® SuperChems™ - ioMosaic Corporation

# A listing of scenario outcomes reaching each building can be produced for more detailed analysis

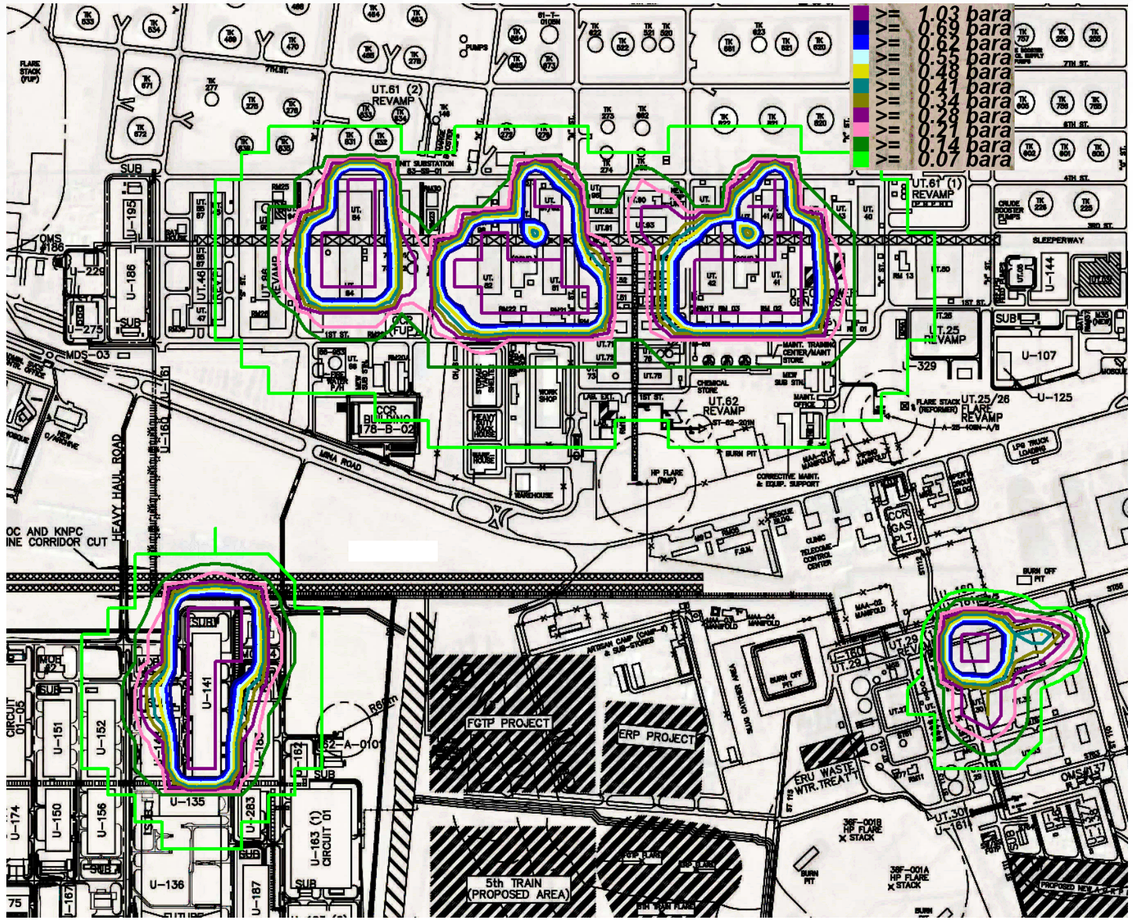
Infrastructure Overpressure Analysis Report

| | A | B | C | D | E | F | G | H |
|---|---|---|---|---|---|---|---|---|
| 1 | ID | | 840A05E4-C275-11E4-9768-B8763FAD8395 | | | | | |
| 2 | Description | | RMP CCR near RM01 | | | | | |
| 3 | Type | | Open - Outdoor | | | | | |
| 4 | Class | | None | | | | | |
| 5 | Process Unit | | RMP-CCR | | | | | |
| 6 | | | | | | | | |
| 7 | | | | | | | | |
| 8 | Overpressure min. bara | Overpressure max. bara | Duration min. ms | Duration max. ms | Impulse min. bara.ms | Impulse max. bara.ms | Cumulative Frequency. /10,000 yrs | Number of Outcomes |
| 9 | | | | | | | | |
| 10 | 0.07 | 0.07 | 6.89 | 126.08 | 0.237 | 4.347 | 1.2470E+00 | 33 |
| 11 | 0.14 | 0.14 | 35.27 | 113.86 | 2.432 | 7.851 | 8.3994E-01 | 12 |
| 12 | 0.21 | 0.21 | 31.17 | 114.51 | 3.224 | 11.843 | 8.3994E-01 | 12 |
| 13 | 0.28 | 0.28 | 27.97 | 123.02 | 3.857 | 16.964 | 8.3994E-01 | 12 |
| 14 | 0.34 | 0.34 | 25.59 | 124.96 | 4.412 | 21.539 | 8.3994E-01 | 12 |
| 15 | 0.41 | 0.41 | 23.34 | 33.99 | 4.827 | 7.030 | 6.5995E-01 | 6 |
| 16 | 0.48 | 0.48 | 30.98 | 31.41 | 7.475 | 7.580 | 5.9996E-01 | 3 |
| 17 | | | | | | | | |
| 18 | | | | | | | | |
| 19 | Number of unique scenarios | | 33 | | | | | |
| 20 | | | | | | | | |
| 21 | Scenario | | | Single Outcome Frequency. | | | | |
| 22 | Name | | | / 10,000 yrs | > 1/100,000 yrs | > 1/10,000 yrs | | |
| 23 | 028- MAA.41.10.G.V-001.CF-D | | | 0.041752 | | | | |
| 24 | 028- MAA.41.10.G.V-001.CF-E | | | 0.014133 | | | | |
| 25 | 028- MAA.41.10.G.V-001.CF-F | | | 0.004111 | | | | |
| 26 | 034- MAA.41.12.G.V-002_4.CF-D | | | | 0.417524 | | | |
| 27 | 034- MAA.41.12.G.V-002_4.CF-E | | | | 0.141329 | | | |
| 28 | 034- MAA.41.12.G.V-002_4.CF-F | | | 0.041106 | | | | |
| 29 | 040- MAA.41.14.G.V-014.CF-D | | | 0.041752 | | | | |
| 30 | 040- MAA.41.14.G.V-014.CF-E | | | 0.014133 | | | | |
| 31 | 040- MAA.41.14.G.V-014.CF-F | | | 0.004111 | | | | |
| 32 | 055- MAA.41.19.G.V-015.CF-D | | | 0.041752 | | | | |
| 33 | 055- MAA.41.19.G.V-015.CF-E | | | 0.014133 | | | | |
| 34 | 055- MAA.41.19.G.V-015.CF-F | | | 0.004111 | | | | |
| 35 | 105- MAA.41.37.G.V-006.CF-D | | | 0.041752 | | | | |
| 36 | 105- MAA.41.37.G.V-006.CF-E | | | 0.014133 | | | | |
| 37 | 105- MAA.41.37.G.V-006.CF-F | | | 0.004111 | | | | |
| 38 | 020- MAA.41.7.G.S.121.100MM-D | | | 0.001804 | | | | |
| 39 | 020- MAA.41.7.G.S.121.100MM-E | | | 0.000611 | | | | |
| 40 | 020- MAA.41.7.G.S.121.100MM-F | | | 0.000178 | | | | |
| 41 | 034- MAA.41.12.G.V-002_4.CF-D | | | 0.087680 | | | | |
| 42 | 034- MAA.41.12.G.V-002_4.CF-E | | | 0.029679 | | | | |
| 43 | 034- MAA.41.12.G.V-002_4.CF-F | | | 0.008632 | | | | |
| 44 | 035- MAA.41.12.G.V-002_4.100MM-D | | | | 0.121856 | | | |
| 45 | 035- MAA.41.12.G.V-002_4.100MM-E | | | 0.041247 | | | | |
| 46 | 035- MAA.41.12.G.V-002_4.100MM-F | | | 0.011997 | | | | |
| 47 | 020- MAA.41.7.G.S.121.100MM-D | | | 0.000118 | | | | |
| 48 | 020- MAA.41.7.G.S.121.100MM-E | | | 0.000040 | | | | |
| 49 | 020- MAA.41.7.G.S.121.100MM-F | | | 0.000012 | | | | |
| 50 | 034- MAA.41.12.G.V-002_4.CF-D | | | 0.037577 | | | | |
| 51 | 034- MAA.41.12.G.V-002_4.CF-E | | | 0.012720 | | | | |
| 52 | 034- MAA.41.12.G.V-002_4.CF-F | | | 0.003700 | | | | |
| 53 | 035- MAA.41.12.G.V-002_4.100MM-D | | | 0.034258 | | | | |
| 54 | 035- MAA.41.12.G.V-002_4.100MM-E | | | 0.011596 | | | | |
| 55 | 035- MAA.41.12.G.V-002_4.100MM-F | | | 0.003373 | | | | |
| 56 | | | | | | | | |
| 57 | | | | | | | | |
| 58 | | | | | | | | |

- Note the difference between cumulative frequencies for each overpressure level and individual outcome frequencies

Source: Process Safety Office® SuperChems™ - ioMosaic Corporation

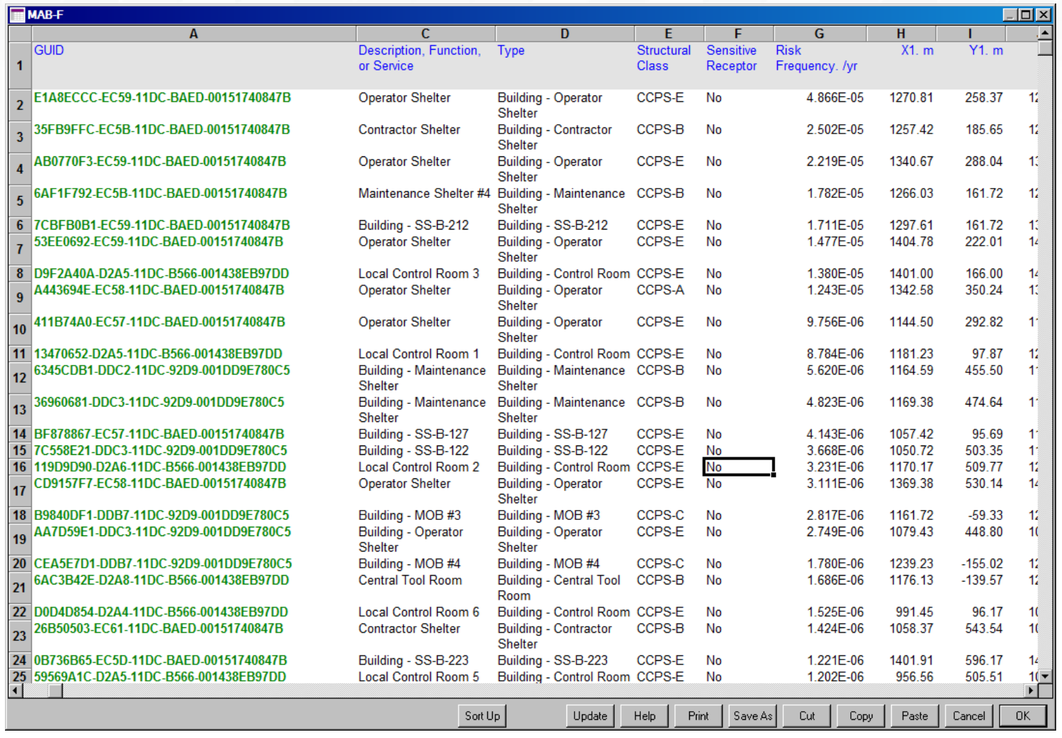
# Overpressure contours from multiple project files can be consolidated by the tool regardless of frequency values




- The overpressure data reduction tool must first be executed for each project file separately
- You can also execute a specific QRA run to display overpressure levels at specific frequencies which is more useful when looking at specific overpressure levels impacting areas of the plant at specific frequencies only

Source: Process Safety Office® SuperChems™ - ioMosaic Corporation

# Building occupant vulnerability risk reports can also be generated automatically for a specific class of occupants



MAB-F

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

Sort Up | Update | Help | Print | Save As | Cut | Copy | Paste | Cancel | OK

Occupant vulnerability risk reports are different building overpressure reports. They use probits to estimate the % fatality of building occupants based on building type and overpressure loading. The frequencies reported here are NOT for structural damage but rather for damage resulting in occupant injury or fatalities

- Occupant vulnerability risk reports can be generated and segmented by occupant class, process unit, etc.
- They can be generated to include all hazard types (toxicity, overpressure, fire) or specifically for one or more hazard types

Source: Process Safety Office® SuperChems™ - ioMosaic Corporation

# The QRA / Facility Siting module of SuperChems™ can be used for both simple and detailed facility siting studies

- For consequence based analysis, the user can define scenarios associated with areas of congestion on the map and execute the overpressure data reduction tools to identify building impacts
- For more detailed analysis, all scenarios leading to flammable vapor clouds can be modeled and the cumulative frequency identified for explosions at different locations including areas of congestion
- A risk based assessment can be generated for each building for occupant vulnerability and / or for structural assessments
- Includes a wide variety of detailed release and consequence models that can easily be used to perform detailed facility siting studies quickly and cost effectively

# 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.

For more information on ioMosaic, please visit: **www.ioMosaic.com**