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AMRISK VERSION 2.5

– documentation of verification tests

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Summary

AMRISK is the software code used for quantitative risk assessment of ammunition storages in Norway and Sweden. As the first part of a major upgrade of the code, AMRISK version 2.5 is finished and verified.

The code of version 2.5 is converted from Fortran to C#. The user interface has been improved with an enhanced use of maps and geographical information. Except for a new model for thermal effects and the replacement of a model for underground storages, the calculation models in AMRISK 2.5 are the same as in AMRISK 2.0.

AMRISK 2.5 is verified by running a series of reference tests. The test results are compared with results from AMRISK 2.0. Version 2.5 gives the same results as version 2.0, except from some minor deviations for unlimited area objects and objects particularly exposed to ground shock.

The verification exposed a program error in version 2.0 that results in too high debris density in a small sector outside tunnels. This is corrected in version 2.5.

Sammendrag

I Norge og Sverige utføres kvantitativ risikoanalyse av ammunisjonslagre med program-verktøyet AMRISK. AMRISK versjon 2.5 er første steget i en større oppgradering av koden, og denne versjonen er ferdig og verifisert.

Programkoden i versjon 2.5 er konvertert fra Fortran til C#. Brukergrensesnittet er forbedret med utvidet bruk av kart og geografisk informasjon. Bortsett fra en ny modell for varmevirkning og erstatning av en modell for underjordiske lagre, er beregningsmodellene i AMRISK 2.5 de samme som i AMRISK 2.0.

AMRISK 2.5 er verifisert ved å kjøre en rekke referanseeksempler med versjon 2.5 og versjon 2.0 og sammenlikne resultatene. AMRISK 2.5 gir de samme resultatene som AMRISK 2.0, bortsett fra noen mindre avvik for objekter med ubegrenset areal og objekter som er spesielt utsatt for grunnsjokk.

Under verifiseringen ble det funnet en programfeil i versjon 2.0 som gir for høy utkasttetthet i en liten sektor utenfor tunneler. Dette er rettet opp i versjon 2.5.

Contents

1 Introduction

AMRISK is a software tool for quantitative risk analysis of ammunition storages. The code is used for storage approvals in Sweden and Norway. The calculations made in the risk analysis include probability of an accident event, physical effects of an explosion, the consequences of the effects to people in different environments, and the number of people exposed to the effects.

AMRISK is the result of a joint Norwegian-Swedish development of the originally Swiss code AMMORISK, which was first introduced in Norway in 1983. The first stage of AMRISK, AMRISK 1.0, is identical to the program AMMORISK as of 30th June 2000. The development into the next main version, AMRISK 2.0, included code conversion from DOS to Windows, functions for data exchange with GIS applications and implementation of some improved physical models. AMRISK 2.0 was released in 2005 [1, 2]. Except from correcting a few coding errors and a new model for thermal effects, no changes are made to AMRISK after this release.

The custodian group that has been maintaining the code since 2005 initiated in 2017 a project for further development of AMRISK. The development is performed in two steps:

In the first stage, the user interface has been improved, and the code is converted to a new framework and a new programming language. The new user interface has made it possible to enhance the use of maps and geographical objects. Besides, a new model for pressure distribution outside tunnels is included, and a couple of obsolete models have been removed. The result of this work is AMRISK version 2.5.

This report describes the tests made to verify the results from AMRISK 2.5. The results are from calculations with models that are unchanged compared to AMRISK 2.0. The results from the two versions should therefore be identical.

In the second step of the upgrade, new and improved models for calculating the risk from accidents in ammunition storages will be developed and implemented. The result will be AMRISK 3.0.

2 Software

2.1 Code

The code of AMRISK 2.0 and previous program versions was written in Fortran. In version 2.5, the programming language is changed to C# [3] using the Microsoft .NET Framework 4.6 as developer platform.

C# is suited for making desktop applications for Windows as it is supported by Microsoft, and there exists a broad range of modern libraries for creating business line applications. C# in itself is a modern programming language and is being continuously improved by its community. The language is used by a large group of professional software developers and support for future development should be good.

The source code consists of separate coherent parts that deal with a specific task. This increases the opportunity for code reuse during future development. The code is comprised of the following main parts:

- Data model: Contains source code representing the domain concepts such as exposed object, chamber, tunnel and situation.
- Storage: Contains source code for storage of data model objects in a database format.
- Risk calculation: Contains source code for calculating the risk given the data model as input.
- Desktop application: Contains source code for editing data model objects in a graphical user interface consisting of dialogs and a map. Visualization of risk calculations is also here.
- Import: Contains source code for importing data from file into the objects represented by the data model.
- Export: Contains source code for exporting the data model and the result of the risk calculation to different formats.

2.2 Calculation algorithms

The calculation algorithms implemented in AMRISK 2.5 are the same as those used in AMRISK 2.0 with a couple of exceptions.

During the verification calculations, it was found that AMRISK 2.0 gives incorrect values of the debris density outside tunnels in the sectors 15-22.5 degrees off the tunnel axis. The error made in the calculations results in too high debris effect. Since the error only affects 1.5% of the area, it was not detected in the examples used for verification of AMRISK 2.0. The algorithm is corrected in version 2.5. Figure 2.1 shows the different isorisk contours calculated by the old and the new, corrected method for debris density.

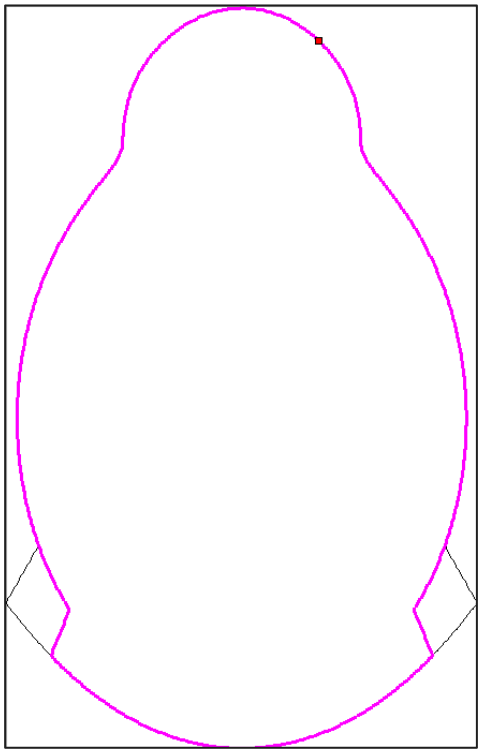


Figure 2.1 Isorisk curves from AMRISK 2.0 (black line) and AMRISK 2.5 (red line) outside an underground facility with a tunnel

The ground shock from an underground chamber depends on the distance from the exposed object to the nearest chamber wall. The distance is found from the given centre line of the chamber and a chamber width. In AMRISK 2.0, this width is found by assuming a rectangular cross section of the chamber. Similar to AMRISK 1.0, the calculation in AMRISK 2.5 is instead based on a circular cross section. The distance used to estimate ground shock might therefore be a bit different in AMRISK 2.0 and AMRISK 2.5. This leads to small differences in the lethality from ground shock at small distances.

3 Models

3.1 Obsolete models

Earth-buried magazines and underground installations of type UG3 are not available as magazine types in AMRISK 2.5, as they were in AMRISK 2.0. The UG3 type underground

facility allows calculation of the effects of a block as a tunnel closure system. This design is not applied in Norway or Sweden, and there are no plans for adopting it. In case facilities including a block device should be built, the model is available and can be implemented in later versions of AMRISK.

The model for earth-buried magazines (EB) refers to a Swiss magazine type not used in Norway or Sweden. The original Swiss model seems to apply for layouts very close to the Swiss type. For more general modelling of structures with heavy cover and low loading density, for example the earth-buried magazine tested by Sweden and Norway in Älvdalen in 2008, the underground models give better agreement than the Swiss EB model, see Figure 3.1.

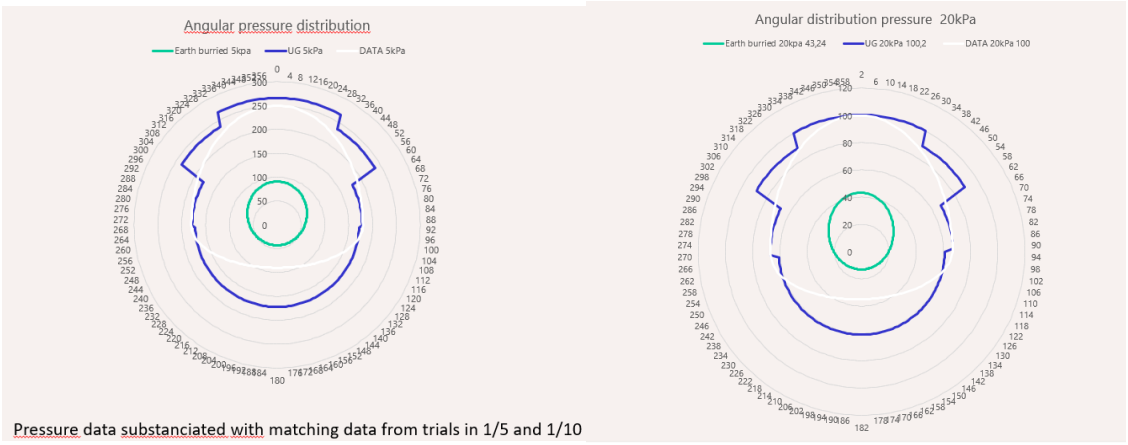


Figure 3.1 *5 kPa and 20 kPa isobars from test with an earth-buried magazine (white line) compared with results from underground model (blue line) and EB model (green line) [4]*

3.2 New underground model

In AMRISK 2.5 the UG3 model is a new model, called "Underground modified for blast". The model uses the method in the original Swiss UG1 model to calculate the pressure p outside the tunnel along the tunnel axis. This is given as [1]

$$\frac{p}{p_a} = \left(\frac{0.7 d_t}{r_p} \right)^{10/9} \tag{3.1}$$

where p_a is the pressure at the adit, d_t is the tunnel diameter, and r_p is the distance along the axis.

The distance r to positions off axis with the same pressure is r_p reduced by the factor F,

$$F = \frac{r}{r_p} = \frac{1}{1 + \left(\alpha/56°\right)^2} \tag{3.2}$$

where α is the angle to the tunnel axis. This relation is implemented in Norwegian regulations [5]. It is also used in AASTP-4 [6] to describe the pressure distribution, but there the pressure is multiplied by F. Another variant is used for the inhabited building distance (IBD) in AASTP-1 [7]:

$$\frac{IBD(\alpha)}{IBD(0)} = \frac{1}{\left(1 + \left(\alpha/56°\right)^2\right)^{0.74}} \tag{3.3}$$

The original underground model (UG1) assumes a circular pressure distribution around a point at the tunnel axis at a distance of 0.43 r_p from the adit [1]. The isobars are then given as

$$\frac{r}{r_p} = \frac{0.57^2 - 0.43^2}{\sqrt{0.57^2 - \left(0.43\sin\alpha\right)^2} - 0.43\cos\alpha} \tag{3.4}$$

In the model for underground installations of Norwegian design (UG2) the isobars are given by [1]

$$\frac{r}{r_p} = \begin{cases} 1 & |\alpha| \le 30° \\ 0.89 & 30° < |\alpha| \le 60° \\ 0.67 & 60° < |\alpha| \le 90° \\ 0.5 & 90° < |\alpha| \le 120° \\ 0.25 & |\alpha| > 120° \end{cases} \tag{3.5}$$

and the pressure is proportional to $r^{-1.42}$.

Figure 3.3 shows isobars given by the different models.

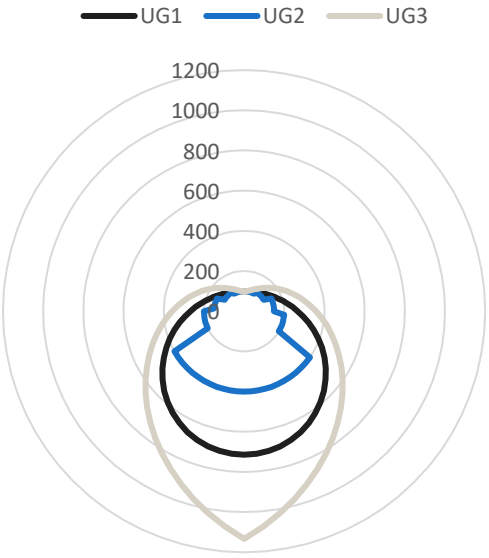


Figure 3.2 Positions with maximum pressure equal to the pressure 100 m behind the tunnel adit according to the underground models in AMRISK 2.5

Possible weaknesses for all the three methods are:

- Equal angular distribution over the calculated pressure range (directional effect is usually stronger for higher pressures)
- Dependence on a steep hill behind the tunnel opening (pressure reflections from the rock face beside and around the tunnel)
- Considerable uncertainties for the 180 degrees sector at the rear of the tunnel adit

3.3 Thermal model

After the release of AMRISK 2.0, a model for the effects and consequences from HD (Hazard Division) 1.3 ammunition was implemented into the AMRISK code. The model is described in AASTP-4 [6]. The model for calculating the heat effects is similar to the Dutch model described in [6]. The thermal model is included in AMRISK 2.5.

4 User interface

4.1 General

4.1.1 Input

Dialogs for user input are based on the dialogs in AMRISK 2.0, since the version 2.5 has the same requirement for input parameters as 2.0 [8]. However, it has been a goal to make the input more visually connected to a map, so the dialogs are built up with menus with the map visible at all times.

The menus available from the main window are:

- *File* that has options for import of input files from AMRISK 2.0 and AMRISK 2.5 and export of files to AMRISK 2.5 or as HTML-files. The file menu can also be used to exit the program.

- *Manage sites* is used to add new sites for analysis, remove sites and select a site for editing. A site contains the magazines and exposed objects that are involved in an analysis.

- *Edit site* opens a dialog with six tabs, where sub-dialogs for *Depot Info*rmation, *Aboveground* magazines, *Underground* facilities, *Exposed Objects*[1], *Situations* and *Isorisk* are used for data input and editing.

- *Calculate risk* presents calculated results from the current site in a child window.

Magazines and exposed objects can be defined or selected by clicking on the map, and their position and geometry can be edited in the map. The map can also be used to collect coordinates or measure distances.

In AMRISK 2.5 the underground installation types are given the names “Underground original”, previously UG1, “Underground Norwegian design”, previously UG2, and “Underground modified for blast”, which is a new model, see chapter 3. The old names, UG1, UG2 and UG3, are still used as acronyms in this report.

4.1.2 Output

The calculated results are shown as a risk-value matrix with detailed effects values available based on the chosen magazine/charge and exposed object in the matrix.

[1]The danger-option (ND/DA) is for now an administrative option and do not change the risk values.

Less weight is put on printed results compared to version 2.0, since the calculated risk values can be copied from the screen and pasted into different applications. Still, the risk results can be exported to Excel spreadsheets.

Calculated isorisk curves are visualized in the map. An option for export of isorisk curves in SOSI-format is provided. SOSI is a Norwegian standard for geographic information [9, 10].

4.2 Maps

The GIS (geographic information system) package in AMRISK is set up to read maps in the file format .mmpk (mobile map package format). Map packages can be created in the GIS software ArcGIS Pro from ESRI [11].

5 Verification tests

The verification tests include three different concepts:

- Comparing results from reference examples
- Comparing ISO-risk contours
- Testing the basic functions calculating effects and values in the source code

The reference examples are designed as real scenarios. The test results show if the combination of physical effects, response, probability and exposure is calculated correctly. The weakness of such tests is the difficulty of ensuring that combinations of the input parameters and geometries are checked across the full range of validity.

The isorisk comparisons give a good test of the horizontal angular dependencies of the results. Similar to the reference examples it is a challenge to get all the possible combinations of input parameters tested. It is also difficult to aggregate other values than individual risk.

The basic function tests are important because they can check all functions in the application over the whole range of validity. The limitations are that they do not test the aggregated values of risk and make sure that all models work correctly together.

The different tests verify that AMRISK 2.5 reproduces values from version 2.0 correctly. It is also recommended to check existing analysis library when converting data to 2.5 format to further verify and reproduce earlier results.

5.1 Reference tests

A series of reference examples have been run with both AMRISK 2.0 and AMRISK 2.5. The examples include all kinds of storages and exposed objects as shown in Table 5.1. Input data for the reference examples are given in appendix A.

The abbreviations used in the table and in paragraph 5.2 are given below.

Potential explosion sites (PES)
FS: Freestanding magazine
EC: Earth-covered magazine
UG1, UG2, UG3: Underground installation 1, 2 and 3

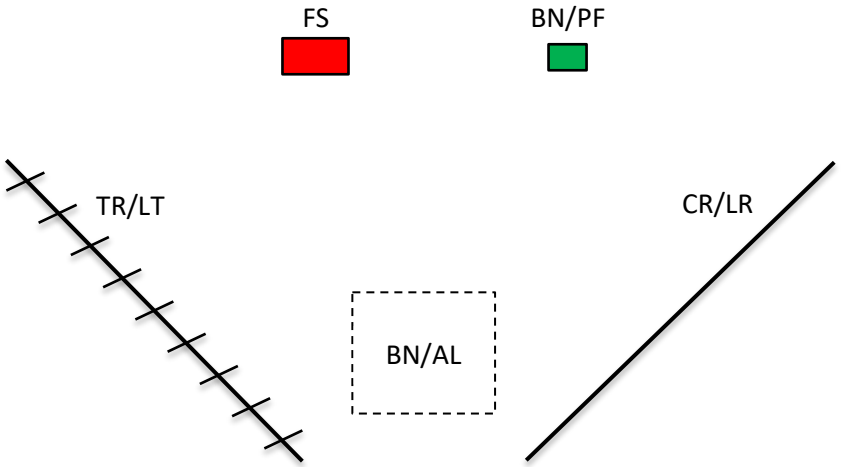
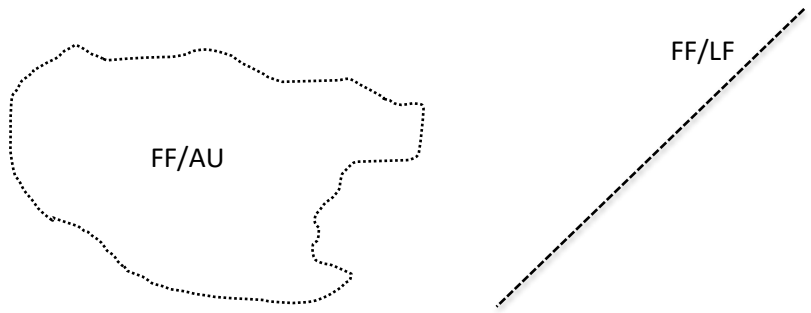
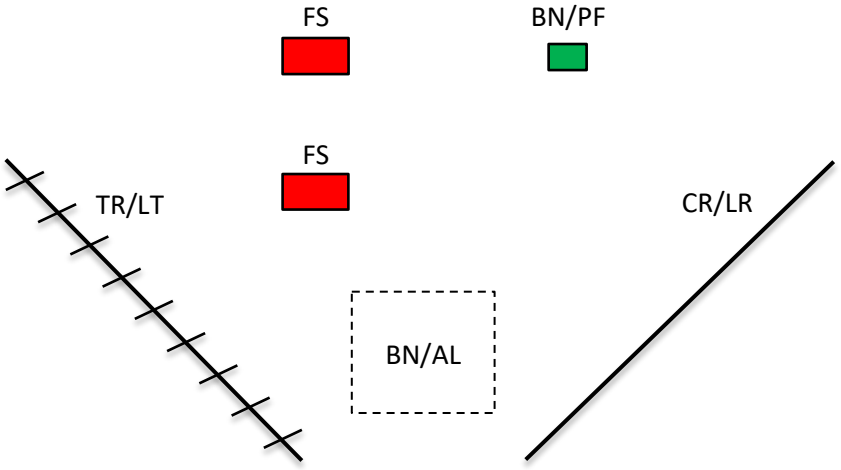
Exposed objects (EO)
BL: Light building
BN: Normal building
BS: Strong building
CR: Car
FF: Free-field
TR: Train

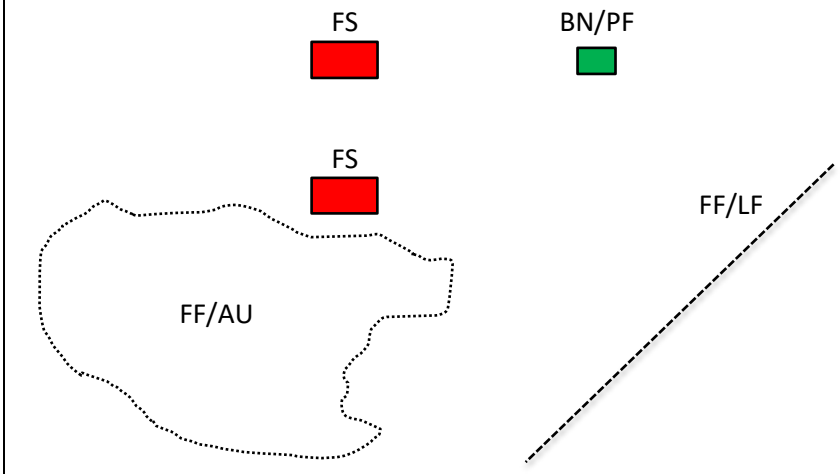
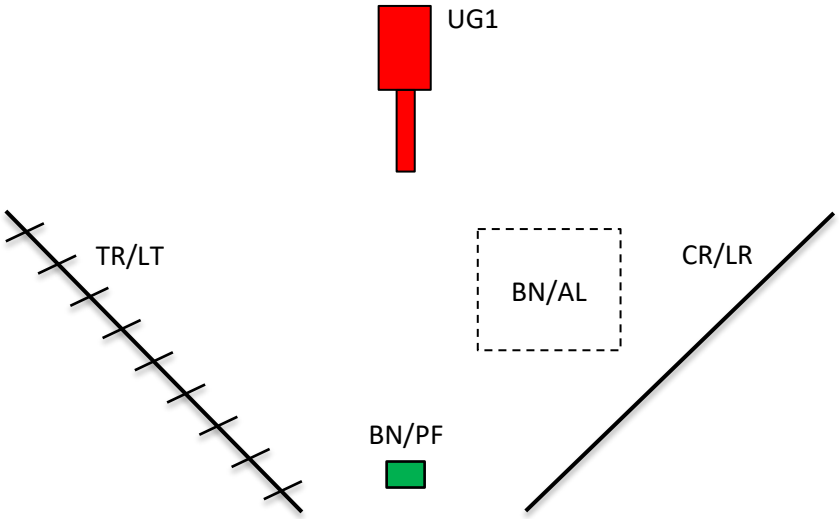
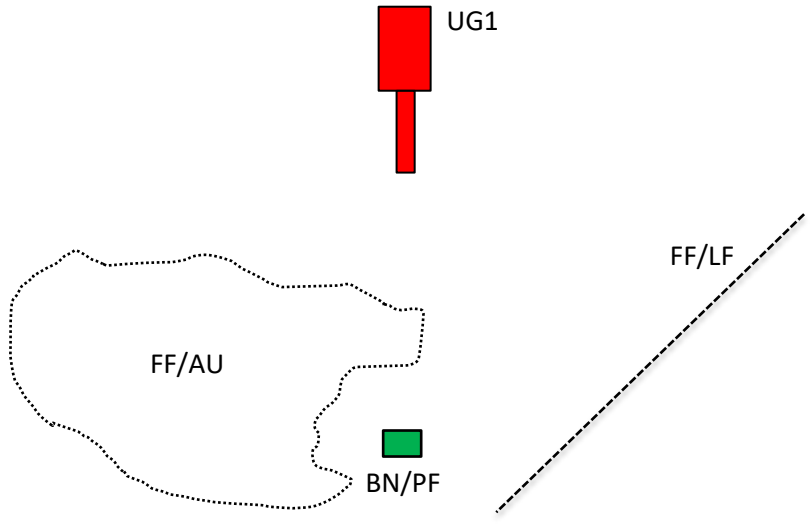
For exposed objects, the symbol NF (no forest) is used for normal conditions and FO for forest and unfavourable conditions.

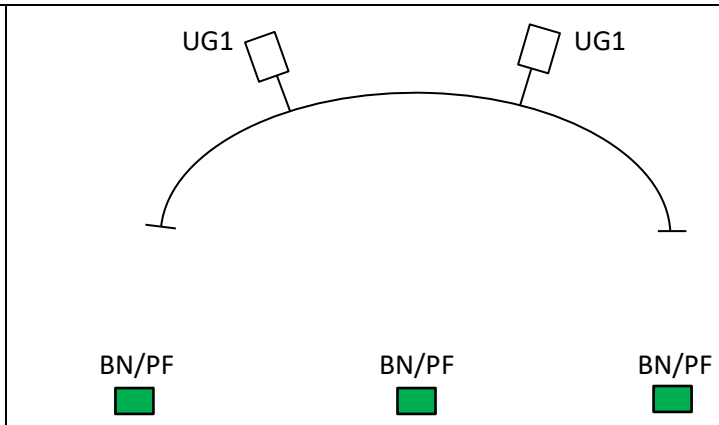
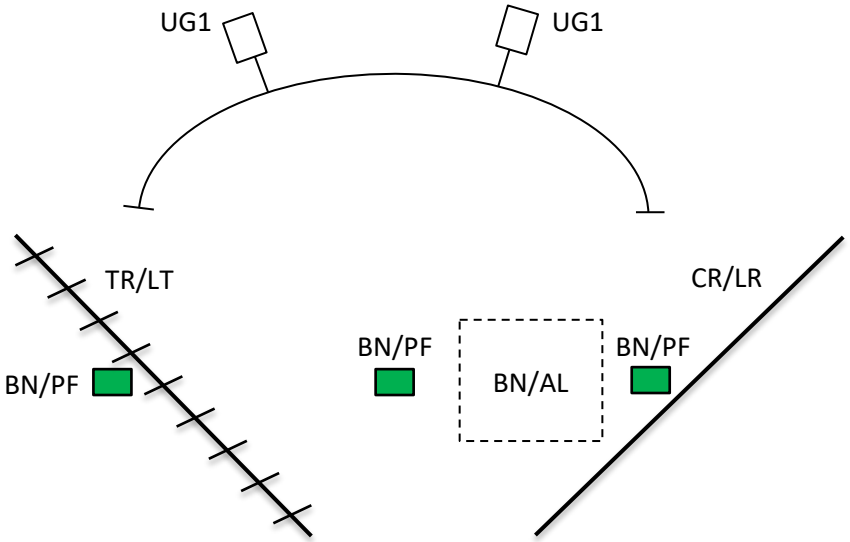
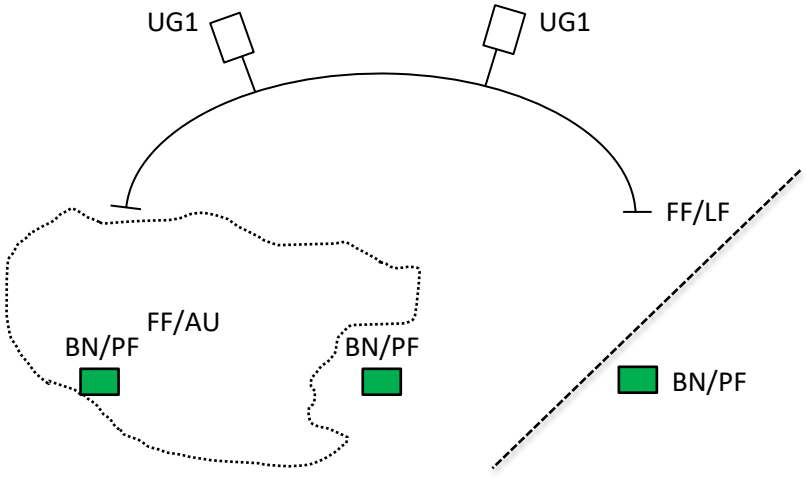
Object shapes
AL: Limited area
AU: Unlimited area
PF: Point-fixed
LF: Linear free-field
LR: Linear road
LT: Linear train

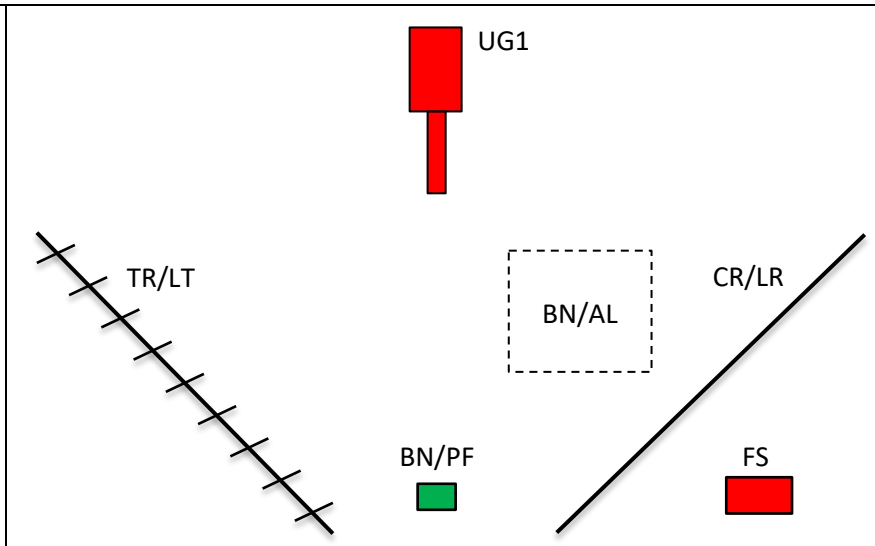
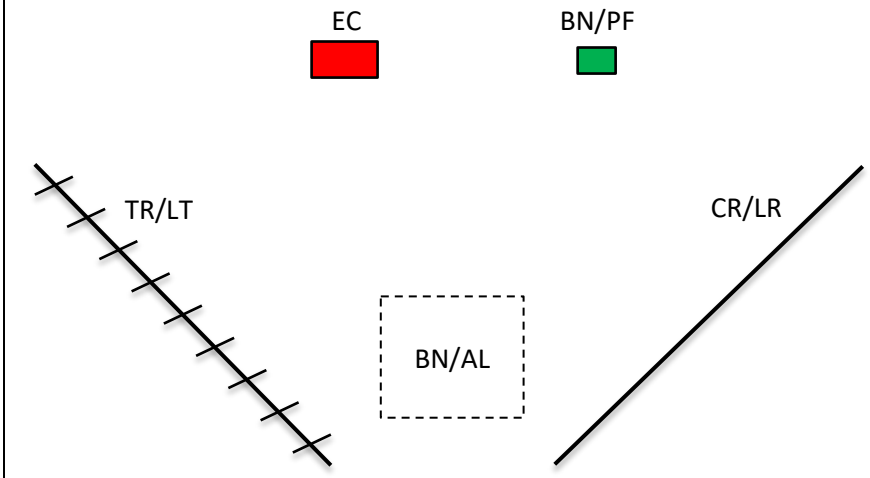
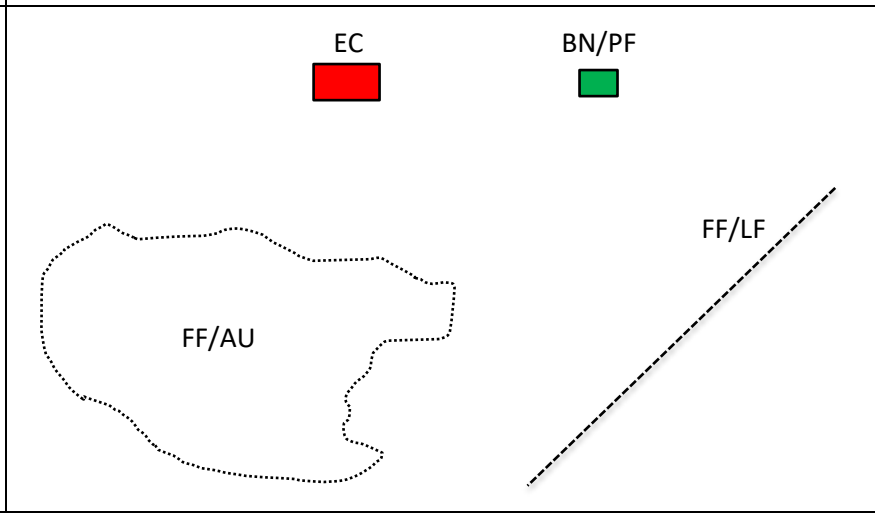
Tunnel adit shape
NO: Narrow opening
WO: Wide opening

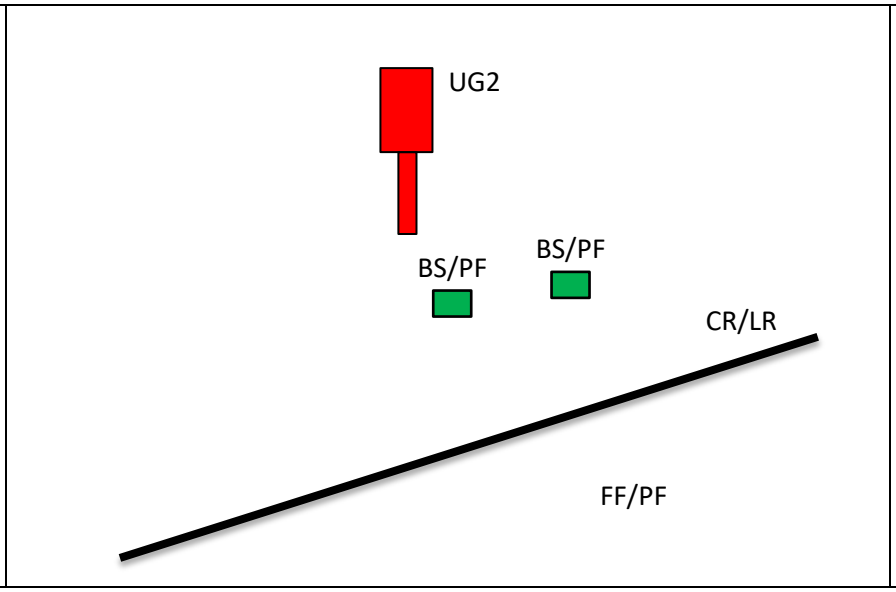
Table 5.1 Ammunition magazines and exposed objects in the different reference examples

Example		Variations
2		
3		
4		

5		
6		Barricade WO/NO
7		

8		Barricade
9		
10		

11	 UG1 TR/LT BN/AL CR/LR BN/PF FS	
12	 EC BN/PF TR/LT CR/LR BN/AL	
13	 EC BN/PF FF/LF FF/AU	

14		

The test results are given in appendix B. They show that AMRISK 2.5 gives the same results as AMRISK 2.0, except for a few small deviations.

The lethality values for people in forest in example 3, 5, 7, 10 and 13 are a bit different in the two versions. The differences are caused by the data handling during the integration over unlimited areas. In example 10, there is a difference of about 2.5 %; for the others the difference is between 0.1 % and 0.7 %. The differences are transferred to the other consequence and risk values. Even if the deviations are negligible, it might be beneficial to make a more robust integration algorithm in AMRISK 3.0.

In example 14 AMRISK 2.5 gives marginally smaller values for house a1 compared to AMRISK 2.0. For house a2, the differences are slightly larger, and the values from AMRISK 2.5 are about 95 % of the values from AMRISK 2.0. The reason for this is the different methods used for calculating the ground shock distance as explained in chapter 2.2.

5.2 Isorisk contours

Isorisk contours have been calculated by AMRISK 2.0 and AMRISK 2.5 for several of the reference examples with some variants. The contours are reported from AMRISK 2.0 and 2.5 in SOSI-file format. The program SOSI-vis is then applied for the comparison of the curves. To make the two versions of the curves visible, the coordinate system is altered for the AMRISK 2.0 plots so that the curves are skewed 5 m in both x and y direction. The contours are shown in appendix C.

The chosen examples capture all types of exposed objects. Since aboveground storages use the same lethality functions it is not necessary to compare all the object types for both freestanding (FS) and earth-covered (EC) magazines, only BN is compared for EC.

The UG1, UG2 and UG3 models for underground magazines have some differences in pressure distributions and debris distributions outside the tunnel adits as described in paragraph 3.2. For a given tunnel debris effect, defined as an equivalent distance, the lethality is however the same for all UG models.

If the rock cover of an underground magazine is insufficient, there will be a crater above the magazine giving air blast and debris. The crater debris results in another equivalent distance with its own function for calculating the lethality. The functions giving equivalent distance and lethality for crater debris are the same for all the underground models.

To ensure that risk in different ranges are plotted correctly, separate comparisons are made of contours of different risk values in reference example 11.

The main purpose of the Grøtteskogen example is to compare isorisk contours when several magazines contribute to the risk.

In all the examples, the isorisk contours from AMRISK 2.5 and AMRISK 2.0 are practically identical.

As pointed out in chapter 2, AMRISK 2.0 gives in some cases incorrect values of the debris density outside tunnels. This may cause discrepancies between contours from the two versions. Figure 2.1 shows an example of that.

5.3 Basic functional tests

To check that the mathematical functions used in the risk calculations are implemented correctly, results from calculations by the new code have been compared with calculations made by spreadsheets. An overview of the functions that were tested is given in appendix D. The input values used in the tests cover every aspect of the calculation algorithms. All the tests were passed [12].

6 Conclusion

Version 2.5 of the ammunition safety software AMRISK is finished and verified.

In AMRISK 2.5 the programming language is converted from Fortran to C#, which is a modern language well suited for future updates of the code. AMRISK 2.5 has an extended GIS-functionality and the possibility to use digital maps more effectively.

The verification of AMRISK 2.5 exposed a program error in version 2.0 that results in too high debris density in a small sector outside tunnels. This is corrected in version 2.5.

It can be concluded that version 2.5 gives the same results as version 2.0, except from some minor deviations concerning exposed objects type AU (area unlimited) and objects close to an underground chamber if they are particularly exposed to ground shock.

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Appendix

A Input values of reference tests

The tables below with input vales from the reference tests are collected from iut-files produced by AMRISK 2.0.

A.1 Abbreviations

DTV: Average daily traffic
Ltrain: Train length
ND: No danger
NI: Not involved
PKZ: Representative number of persons (Personenkennzahl)
SD: Relative duration of situation
Tind: Maximum individual presence
TPW: Trains per week

A.2 Reference example 2

M A G A Z I N E / C H A M B E R :
D A T A: Ref ex 2 Adm No: 1 Printed: 2 April 2019 /14:35:15
User Ref: CE

Number: 1 Magazine name: 1 Type: FREESTANDING MAGAZINE

General Information: Name of Depot: Ref ex 2 Depot number: 1

Dimensions: Length (m): 20.0 Width (m): 10.0 Height (m): 4.0 Volume (m3): 800.0

Type of Access: Longitudinal access

Debris masses: Building (t): 300.0

Coordinates: Centre x (m): 0.0 Centre y (m): 0.0 Altitude (m): 0.0
Axis x (m): 50.0 Axis y (m): 0.0

Number of charges: 1

Charge number: 1 NEQ: 20.00 Gross NEQ: 117.65 Probability 32.65 * 10E-6 Concrete freestanding magazine

E X P O S E D:
O B J E C T S: Ref ex 2 Adm No: 1 Printed: 2 April 2019 /14:35:15
User Ref: CE

Object Ref	Object Name	Exp./Calc. Type	PKZ/DTV	Tind	Ltrain or Width	Velocity (km/h)	Person Type	Coordinates X	Coordinates Y	Altitude	Danger	Object Ident
A	House	BN PF	4.000	0.900	-	-	NI	200.	0.	0.0	ND NF	1
B	Road	CR LR	2000.000	-	-	50.0	NI	400.	300.	0.0	ND NF	2
								300.	-700.	0.0	ND NF	
C	Train	TR LT	1.000	-	100.0	100.0	NI	-300.	300.	0.0	ND NF	3
								-150.	-800.	0.0	ND NF	
D	Cottage area	BN AL	4000.000	0.121	200.0	-	NI	-100.	-400.	0.0	ND NF	4
								-100.	-200.	0.0	ND NF	

S I T U A T I O N S : Printed: 2 April 2019 /14:35:15
P R E S E N C E F A C T O R S : Ref ex 2 Adm No: 1 User Ref: CE

Ref.	Name	Ident.	1/N/O Night	2/D/O Day	3/E/O Evening	4/W/O Weekend	5/T/O Train
========= O b j e c t ==========		SD=	0.3750/ 1	0.2976/ 1	0.1488/ 1	0.1786/ 1	0.0000/ 1
		TPW=	0.0/	0.0/	0.0/	0.0/	60.0/ 3
A	House	1	1.000	0.250	0.750	0.750	0.250
B	Road	2	0.050	0.500	0.200	0.250	0.500
C	Train	3	0.000	0.000	0.000	0.000	1.000
D	Cottage area	4	0.135	0.101	0.135	0.101	0.101

Saved: 2 April 2019 /File Code: C:\AMRISK\ref_ex_2.amr /User name: Fortv Global X/Y: 0. 0.

A.3 Reference example 3

M A G A Z I N E / C H A M B E R : Printed: 17 April 2019 /11:21:21
D A T A: Ref ex 3 Adm No: User Ref: ES

Number: 1 Magazine name: 1 Type: FREESTANDING MAGAZINE

General Information: Name of Depot: Ref ex 3 Depot number:

Dimensions: Length (m): 20.0 Width (m): 10.0 Height (m): 4.0 Volume (m3): 800.0

Type of Access: Longitudinal access

Debris masses: Building (t): 300.0

Coordinates: Centre x (m): 0.0 Centre y (m): 0.0 Altitude (m): 0.0
Axis x (m): 50.0 Axis y (m): 0.0

Number of charges: 1

Charge number: 1 NEQ: 20.00 Gross NEQ: 117.65 Probability 32.65 * 10E-6 Concrete freestanding magazine

E X P O S E D: Printed: 17 April 2019 /11:21:21
O B J E C T S: Ref ex 3 Adm No: User Ref: ES

Object Ref	Object Name	Exp./Calc. Type	PKZ/DTV	Tind	Ltrain or Width	Velocity (km/h)	Person Type	Coordinates X	Coordinates Y	Altitude	Danger	Object Ident
A	House	BN PF	4.000	0.900	-	-	NI	200.	0.	0.0	ND NF	1
B	Path	FF LF	10.000				NI	400.	300.	0.0	ND NF	2
								300.	-700.	0.0	ND NF	
C	People in forest	FF AU	4.000	-	-	-	NI					3

S I T U A T I O N S : Printed: 17 April 2019 /11:21:21
P R E S E N C E F A C T O R S : Ref ex 3 Adm No: User Ref: ES

Ref.	Name	Ident.	TPW=	1/N/O Night 0.0/	2/D/O Day 0.0/	3/E/O Evening 0.0/	4/W/O Weekend 0.0/
========= O b j e c t ==========			SD=	0.3750/ 1	0.2976/ 1	0.1488/ 1	0.1786/ 1
A	House	1		1.000	0.250	0.750	0.750
B	Path	2		0.000	0.300	0.300	0.400
C	People in forest	3		0.000	0.250	0.500	0.750

Saved: 17 April 2019 /File Code: C:\AMRISK\ref_ex_31.amr /User name: Fortv Global X/Y: 0. 0.

A.4 Reference example 4

M A G A Z I N E / C H A M B E R : Printed: 17 April 2019 /10:55:29
D A T A: Ref ex 4 Adm No: 1 User Ref: ES

Number: 1 Magazine name: 1 Type: FREESTANDING MAGAZINE

General Information:Name of Depot: Ref ex 4 Depot number: 1

Dimensions: Length (m): 20.0 Width (m): 10.0 Height (m): 4.0 Volume (m3): 800.0

Type of Access: Longitudinal access

Debris masses: Building (t): 300.0

Coordinates: Centre x (m): 0.0 Centre y (m): 0.0 Altitude (m): 0.0
Axis x (m): 50.0 Axis y (m): 0.0

Number of charges: 1

Charge number: 1 NEQ: 20.00 Gross NEQ: 117.65 Probability 32.65 * 10E-6 Direct probability input

---

M A G A Z I N E / C H A M B E R : Printed: 17 April 2019 /10:55:29
D A T A: Ref ex 4 Adm No: 1 User Ref: ES

Number: 2 Magazine name: 2 Type: FREESTANDING MAGAZINE

General Information:Name of Depot: Ref ex 4 Depot number: 1

Dimensions: Length (m): 20.0 Width (m): 10.0 Height (m): 4.0 Volume (m3): 800.0

Type of Access: Longitudinal access

Debris masses: Building (t): 300.0

Coordinates: Centre x (m): 0.0 Centre y (m): -100.0 Altitude (m): 0.0
Axis x (m): 50.0 Axis y (m): -100.0

Number of charges: 1

Charge number: 1 NEQ: 20.00 Gross NEQ: 117.65 Probability 32.60 * 10E-6 Direct probability input

---

E X P O S E D: Printed: 17 April 2019 /10:55:29
O B J E C T S: Ref ex 4 Adm No: 1 User Ref: ES

Object Ref	Object Name	Exp./Calc. Type	PKZ/DTV	Tind	Ltrain or Width	Velocity (km/h)	Person Type	Coordinates X	Coordinates Y	Altitude	Danger	Object Ident
A	House	BN PF	4.000	0.900	-	-	NI	200.	0.	0.0	ND NF	1
B	Road	CR LR	2000.000	-	-	50.0	NI	400.	300.	0.0	ND NF	2

```
                                                                                                                  300.     -700.          0.0     ND NF
C          Train                     TR LT     1.000        -        100.0        100.0          NI                                                          3
                                                                                                                 -300.      300.          0.0     ND NF
                                                                                                                 -150.     -800.          0.0     ND NF

D          Cottage area              BN AL  4000.000      0.121      200.0            -          NI                                                          4
                                                                                                                 -100.     -400.          0.0     ND NF
                                                                                                                 -100.     -200.          0.0     ND NF
```

```
S I T U A T I O N S :                                                                                    Printed: 17 April    2019 /10:55:29
P R E S E N C E   F A C T O R S :            Ref ex 4                                 Adm No: 1           User Ref: ES
```

Ref.	Name	Ident.	1/N/29 Night	2/D/29 Day	3/E/29 Evening	4/W/29 Weekend	5/T/29 Train
========= O b j e c t ==========		SD= TPW=	0.3750/ 1 0.0/	0.2976/ 1 0.0/	0.1488/ 1 0.0/	0.1786/ 1 0.0/	0.0000/ 1 60.0/ 3
A	House	1	1.000	0.250	0.750	0.750	0.250
B	Road	2	0.050	0.500	0.200	0.250	0.500
C	Train	3	0.050	0.500	0.200	0.250	1.000
D	Cottage area	4	0.135	0.101	0.135	0.101	0.101

```
Saved: 17 April    2019 /File Code: C:\AMRISK\Ref_ex_41.amr                    /User name: Fortv                  Global X/Y:                    0.         0.
```


A.5 Reference example 5

```
M A G A Z I N E / C H A M B E R :                                                                                Printed: 21 September2020 /11:11:32
D A T A:                                    ref_ex_51                                Adm No: 1           User Ref: ES
```

```
Number:      1  Magazine name: 1                                Type:           FREESTANDING MAGAZINE

General Information:Name of Depot:  ref_ex_51                                  Depot number:  1

Dimensions:         Length (m):       20.0     Width (m):       10.0        Height (m):            4.0          Volume (m3):       800.0

Type of Access:     Longitudinal access

Debris masses:      Building (t):    300.0
```

Coordinates: Centre x (m): 0.0 Centre y (m): 0.0 Altitude (m): 0.0
Axis x (m): 50.0 Axis y (m): 0.0

Number of charges: 1

Charge number: 1 NEQ: 20.00 Gross NEQ: 117.60 Probability 32.64 * 10E-6 Concrete freestanding magazine

---

M A G A Z I N E / C H A M B E R : Printed: 21 September2020 /11:11:32
D A T A: ref_ex_51 Adm No: 1 User Ref: ES

Number: 2 Magazine name: 2 Type: FREESTANDING MAGAZINE

General Information:Name of Depot: ref_ex_51 Depot number: 1

Dimensions: Length (m): 20.0 Width (m): 10.0 Height (m): 4.0 Volume (m3): 800.0

Type of Access: Longitudinal access

Debris masses: Building (t): 300.0

Coordinates: Centre x (m): 0.0 Centre y (m): -100.0 Altitude (m): 0.0
Axis x (m): 50.0 Axis y (m): -100.0

Number of charges: 1

Charge number: 1 NEQ: 20.00 Gross NEQ: 117.65 Probability 32.65 * 10E-6 Concrete freestanding magazine

---

E X P O S E D: Printed: 21 September2020 /11:11:32
O B J E C T S: ref_ex_51 Adm No: 1 User Ref: ES

Object Ref	Object Name	Exp./Calc. Type	PKZ/DTV	Tind	Ltrain or Width	Velocity (km/h)	Person Type	Coordinates X	Coordinates Y	Altitude	Danger	Object Ident
A	House	BN PF	4.000	0.900	-	-	NI	200.	0.	0.0	ND NF	1
B	Path	FF LF	10.000				NI	400.	300.	0.0	ND NF	2
								300.	-700.	0.0	ND NF	
C	People forest	FF AU	4.000	-	-	-	NI					3

```
S I T U A T I O N S :                                                                                                    Printed: 21 September2020 /11:11:32
P R E S E N C E   F A C T O R S :          ref_ex_51                              Adm No: 1                               User Ref: ES
```

			1/N/31 Night	2/D/31 Day	3/W/31 Evening	4/ /31 Weekend
========= O b j e c t ==========		SD=	0.3750/ 1	0.2976/ 1	0.1488/ 1	0.1786/ 1
Ref.	Name	Ident. TPW=	0.0/	0.0/	0.0/	0.0/
A	House	1	1.000	0.250	0.750	0.750
B	Path	2	0.000	0.300	0.300	0.400
C	People forest	3	0.000	0.250	0.500	0.750

```
Saved: 28 May    2020 /File Code: C:\AMRISK\Ref_ex_41.amr                    /User name: Fortv                 Global X/Y:                  0.         0.
```

A.6 Reference example 6

```
M A G A Z I N E / C H A M B E R :                                                                                        Printed: 18 October  2019 /13: 4:36
D A T A:                                  Ref ex 5                               Adm No: 1                               User Ref: CE
Number:      1  Magazine name: 1                                Type:           ROCK ORIGINAL CH ORG-OPT

General Information:Name of Depot:  Ref ex 5                                    Depot number:  1

Dimensions:         Length (m):       60.0     Width (m):       20.0          Height (m):             5.0          Volume (m3):      6000.0

                                                                               Cross section (m2):   100.0          Chamber exit area:  20.0

Cover:              Earth (m):         0.0     Rock (m):        30.0

Type of Access:     Longitudinal access

Chamber lining:     SHOTCRETE

Coordinates:        Centre x (m):    100.0     Centre y (m):   430.0          Altitude (m):           0.0
                    Axis x (m):      100.0     Axis y (m):     400.0

Crater:             Crater x (m):    100.0     Crater y (m):   410.0          Altitude (m):          30.0
                    2.pt x (m):      100.0     2.pt y (m):     380.0          Altitude (m):          25.0

Number of charges:   1

Charge number:       1   NEQ: 100.00    Gross NEQ:  588.00     Probability    89.20  * 10E-6                          Mix A assumed (mixed storage)
```

T U N N E L:
D A T A: Ref ex 5 Adm No: 1 Printed: 18 October 2019 /13: 4:36
User Ref: CE

Tunnel: 1 1 ROCK ORIGINAL CH ORG-OPT

Chamber Entrance: Coordinates (X/Y): 100. / 400. Area Tunnel (m2): 20.00
Tunnel Exit: Coordinates (X/Y): 100. / 300. Area Tunnel (m2): 20.00
2. Point Tunnel Exit: Coordinates (X/Y): 100. / 320.
Debris Geometry: Type: Small Angles Length of Tunnel (m): 100.0

Data of Terrain Limitation (m)	Sector	1	2	3	4	5	6	7	8	9	10	11	12
	30.0 deg	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Vertical 22.5 deg	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-
	Angle 15.0 deg	-	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-	
	7.5 deg	-	-	0.0	0.0	0.0	0.0	0.0	0.0			-	-
	5.0 deg	-	-	-	-	0.0	0.0	0.0	0.0	-	-	-	-

Element of Tunnel No	Type	Area F1 (m2)	Area F2 (m2)	Lining	Length (m)	Calcula-tion Case	Angle (deg)	Pressure p2/p1	Duration t2/t1	Rema
1	Friction element	20.00	20.00	SHOTCRETE	100.0					

E X P O S E D:
O B J E C T S: Ref ex 5 Adm No: 1 Printed: 18 October 2019 /13: 4:36
User Ref: CE

Object Ref	Object Name	Exp./Calc. Type	PKZ/DTV	Tind	Ltrain or Width	Velocity (km/h)	Person Type	Coordinates X	Coordinates Y	Altitude	Danger	Object Ident
A	House	BN PF	4.000	0.900	-	-	NI					1
								200.	0.	0.0	ND NF	
B	Road	CR LR	2000.000	-	-	50.0	NI					2
								400.	300.	0.0	ND NF	
								300.	-700.	0.0	ND NF	
C	Train	TR LT	1.000	-	100.0	100.0	NI					3
								-300.	300.	0.0	ND NF	
								-150.	-800.	0.0	ND NF	

```
D          Cottage area              BN AL  4000.000      0.121      200.0           -          NI                                                                  4
                                                                                                                  -100.     -400.          0.0     ND NF
                                                                                                                  -100.     -200.          0.0     ND NF
```

```
S I T U A T I O N S :                                                                                                                    Printed: 18 October  2019 /13: 4:36
P R E S E N C E   F A C T O R S :            Ref ex 5                                  Adm No: 1                                         User Ref: CE
```

Ref.	Name	Ident.	1/N/O Night	2/D/O Day	3/E/O Evening	4/W/O Weekend	5/T/O Train
========= O b j e c t ==========		SD=	0.3750/ 1	0.2976/ 1	0.1488/ 1	0.1786/ 1	0.0000/ 1
		TPW=	0.0/	0.0/	0.0/	0.0/	60.0/ 3
A	House	1	1.000	0.250	0.750	0.750	0.250
B	Road	2	0.050	0.500	0.200	0.250	0.500
C	Train	3	0.000	0.000	0.000	0.000	1.000
D	Cottage area	4	0.135	0.101	0.135	0.101	0.101

```
Saved: 18 October  2019 /File Code: C:\AMRISK\ref_ex_6.amr                    /User name: Fortv                  Global X/Y:                    0.         0.
```


A.7 Reference example 7

```
M A G A Z I N E / C H A M B E R :                                                                                                        Printed:  3 February 2020 /14:50:58
D A T A:                                     Ref ex 7                                  Adm No: 1                                     User Ref: CE
```

```
Number:      1  Magazine name: 1                                Type:           ROCK ORIGINAL CH ORG-OPT
```

```
General Information:Name of Depot:  Ref ex 7                                  Depot number:  1

Dimensions:         Length (m):       60.0     Width (m):       20.0        Height (m):            5.0          Volume (m3):      6000.0

Cover:              Earth (m):         0.0     Rock (m):        30.0

Type of Access:     Longitudinal access

Chamber lining:     SHOTCRETE

Coordinates:        Centre x (m):    100.0     Centre y (m):   430.0        Altitude (m):          0.0
                    Axis x (m):      100.0     Axis y (m):     400.0
```

Crater: Crater x (m): 100.0 Crater y (m): 410.0 Altitude (m): 30.0
2.pt x (m): 100.0 2.pt y (m): 380.0 Altitude (m): 25.0

Number of charges: 1

Charge number: 1 NEQ: 100.00 Gross NEQ: 588.00 Probability 89.20 * 10E-6 Mix A assumed (mixed storage)

T U N N E L: Printed: 3 February 2020 /14:50:58
D A T A: Ref ex 7 Adm No: 1 User Ref: CE

Tunnel: 1 1 ROCK ORIGINAL CH ORG-OPT

Chamber Entrance: Coordinates (X/Y): 100. / 400. Area Tunnel (m2): 20.00
Tunnel Exit: Coordinates (X/Y): 100. / 300. Area Tunnel (m2): 20.00
2. Point Tunnel Exit: Coordinates (X/Y): 100. / 320.
Debris Geometry: Type: Small Angles Length of Tunnel (m): 100.0

Data of Terrain Limitation (m)	Sector	1	2	3	4	5	6	7	8	9	10	11	12
	30.0 deg	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Vertical Angle	22.5 deg	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-
	15.0 deg	-	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-	
	7.5 deg	-	-	0.0	0.0	0.0	0.0	0.0	0.0			-	-
	5.0 deg	-	-	-	-	0.0	0.0	0.0	0.0	-	-	-	-

Element of Tunnel No	Type	Area F1 (m2)	Area F2 (m2)	Lining	Length (m)	Calculation Case	Angle (deg)	Pressure p2/p1	Duration t2/t1	Rema
1	Friction element	20.00	20.00	SHOTCRETE	100.0					

E X P O S E D: Printed: 3 February 2020 /14:50:58
O B J E C T S: Ref ex 7 Adm No: 1 User Ref: CE

Object Ref	Object Name	Exp./Calc. Type	PKZ/DTV	Tind	Ltrain or Width	Velocity (km/h)	Person Type	Coordinates X	Coordinates Y	Altitude	Danger	Object Ident
A	House	BN PF	4.000	0.900	-	-	NI	200.	0.	0.0	ND NF	1
B	Path	FF LF	10.000				NI	400.	300.	0.0	ND NF	2

								300.	-700.	0.0	ND NF
C	People forest	FF AU	4.000	-	-	-	NI				3

SITUATIONS:
PRESENCE FACTORS: Ref ex 7 Adm No: 1

Printed: 3 February 2020 /14:50:58
User Ref: CE

Ref.	Name	Ident.	1/N/O Night	2/D/O Day	3/E/O Evening	4/W/O Weekend
========= Object ==========		SD=	0.3750/ 1	0.2976/ 1	0.1488/ 1	0.1786/ 1
		TPW=	0.0/	0.0/	0.0/	0.0/
A	House	1	1.000	0.250	0.750	0.750
B	Path	2	0.000	0.300	0.300	0.400
C	People forest	3	0.000	0.250	0.500	0.750

Saved: 3 February 2020 /File Code: C:\AMRISK\ref_ex_7.amr /User name: Fortv Global X/Y: 0. 0.

A.8 Reference example 8

MAGAZINE/CHAMBER:
DATA: Ref ex 8 Adm No: 1

Printed: 3 February 2020 /13:34:34
User Ref: CE

Number: 1 Magazine name: 1 Type: ROCK ORIGINAL CH ORG-OPT

General Information:	Name of Depot:	Ref ex 8			Depot number:	1		
Dimensions:	Length (m):	60.0	Width (m):	20.0	Height (m):	5.0	Volume (m3):	6000.0
					Cross section (m2):	100.0	Chamber exit area:	20.0
Cover:	Earth (m):	0.0	Rock (m):	30.0				
Type of Access:	Longitudinal access							
Chamber lining:	SHOTCRETE							
Coordinates:	Centre x (m):	100.0	Centre y (m):	430.0	Altitude (m):	0.0		
	Axis x (m):	100.0	Axis y (m):	400.0				

Crater: Crater x (m): 100.0 Crater y (m): 410.0 Altitude (m): 30.0
2.pt x (m): 100.0 2.pt y (m): 380.0 Altitude (m): 25.0

Number of charges: 1

Charge number: 1 NEQ: 100.00 Gross NEQ: 588.00 Probability 89.20 * 10E-6 Mix A assumed (mixed storage)

T U N N E L: Printed: 3 February 2020 /13:34:34
D A T A: Ref ex 8 Adm No: 1 User Ref: CE

Tunnel: 2 1 ROCK ORIGINAL CH ORG-OPT

Chamber Entrance: Coordinates (X/Y): 100. / 400. Area Tunnel (m2): 20.00
Tunnel Exit: Coordinates (X/Y): 300. / 250. Area Tunnel (m2): 20.00
2. Point Tunnel Exit: Coordinates (X/Y): 300. / 270.
Debris Geometry: Type: Small Angles Length of Tunnel (m): 244.0

Data of Terrain Limitation (m)	Sector	1	2	3	4	5	6	7	8	9	10	11	12
	30.0 deg	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Vertical	22.5 deg	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-
Angle	15.0 deg	-	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-	
	7.5 deg	-	-	0.0	0.0	0.0	0.0	0.0	0.0			-	-
	5.0 deg	-	-	-	-	0.0	0.0	0.0	0.0	-	-	-	-

Element of Tunnel No	Type	Area F1 (m2)	Area F2 (m2)	Lining	Length (m)	Calculation Case	Angle (deg)	Pressure p2/p1	Duration t2/t1	Rema
1	Friction element	20.00	20.00	SHOTCRETE	10.0					
2	Junction, joining	20.00	20.00	SHOTCRETE		Secondary Case	90.0			
3	Friction element	20.00	20.00	SHOTCRETE	244.0					

M A G A Z I N E / C H A M B E R : Printed: 3 February 2020 /13:34:34
D A T A: Ref ex 8 Adm No: 1 User Ref: CE

Number: 2 Magazine name: 2 Type: ROCK ORIGINAL CH ORG-OPT

General Information:Name of Depot: Ref ex 8 Depot number: 1

Dimensions: Length (m): 60.0 Width (m): 20.0 Height (m): 5.0 Volume (m3): 6000.0

Cross section (m2): 100.0 Chamber exit area: 20.0

Cover: Earth (m): 0.0 Rock (m): 30.0

Type of Access: Longitudinal access

Chamber lining:

Coordinates: Centre x (m): 200.0 Centre y (m): 430.0 Altitude (m): 0.0
Axis x (m): 200.0 Axis y (m): 400.0

Crater: Crater x (m): 200.0 Crater y (m): 410.0 Altitude (m): 30.0
2.pt x (m): 200.0 2.pt y (m): 380.0 Altitude (m): 25.0

Number of charges: 1

Charge number: 1 NEQ: 100.00 Gross NEQ: 588.00 Probability 89.20 * 10E-6 Mix A assumed (mixed storage)

T U N N E L: Printed: 3 February 2020 /13:34:34
D A T A: Ref ex 8 Adm No: 1 User Ref: CE

Tunnel: 1 2 ROCK ORIGINAL CH ORG-OPT

Chamber Entrance: Coordinates (X/Y): 200. / 400. Area Tunnel (m2): 20.00
Tunnel Exit: Coordinates (X/Y): 0. / 250. Area Tunnel (m2): 20.00
2. Point Tunnel Exit: Coordinates (X/Y): 0. / 270.
Debris Geometry: Type: Small Angles Length of Tunnel (m): 244.0

Data of Terrain Limitation (m)	Sector	1	2	3	4	5	6	7	8	9	10	11	12
	30.0 deg	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Vertical Angle	22.5 deg	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-
	15.0 deg	-	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-	
	7.5 deg	-	-	0.0	0.0	0.0	0.0	0.0	0.0			-	-
	5.0 deg	-	-	-	-	0.0	0.0	0.0	0.0	-	-	-	-

Element of Tunnel No	Type	Area F1 (m2)	Area F2 (m2)	Lining	Length (m)	Calculation Case	Angle (deg)	Pressure p2/p1	Duration t2/t1	Rema
1	Friction element	20.00	20.00	SHOTCRETE	10.0					
2	Junction, joining	20.00	20.00	SHOTCRETE		Main Case	90.0			
3	Friction element	20.00	20.00	SHOTCRETE	244.0					

T U N N E L: Printed: 3 February 2020 /13:34:34
D A T A: Ref ex 8 Adm No: 1 User Ref: CE

Tunnel: 2 2 ROCK ORIGINAL CH ORG-OPT

Chamber Entrance: Coordinates (X/Y): 200. / 400. Area Tunnel (m2): 20.00
Tunnel Exit: Coordinates (X/Y): 300. / 250. Area Tunnel (m2): 20.00
2. Point Tunnel Exit: Coordinates (X/Y): 300. / 270.
Debris Geometry: Type: Small Angles Length of Tunnel (m): 172.0

Data of Terrain Limitation (m)	Sector	1	2	3	4	5	6	7	8	9	10	11	12
	30.0 deg	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Vertical Angle	22.5 deg	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-
	15.0 deg	-	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-	
	7.5 deg	-	-	0.0	0.0	0.0	0.0	0.0	0.0			-	-
	5.0 deg	-	-	-	-	0.0	0.0	0.0	0.0	-	-	-	-

Element of Tunnel No	Type	Area F1 (m2)	Area F2 (m2)	Lining	Length (m)	Calculation Case	Angle (deg)	Pressure p2/p1	Duration t2/t1	Rema
1	Friction element	20.00	20.00	SHOTCRETE	10.0					
2	Junction, joining	20.00	20.00	SHOTCRETE		Secondary Case	90.0			
3	Friction element	20.00	20.00	SHOTCRETE	172.0					

E X P O S E D: Printed: 3 February 2020 /13:34:34
O B J E C T S: Ref ex 8 Adm No: 1 User Ref: CE

Object Ref	Object Name	Exp./Calc. Type	PKZ/DTV	Tind	Ltrain or Width	Velocity (km/h)	Person Type	Coordinates X	Y	Altitude	Danger	Object Ident
A	House	BN PF	4.000	0.900	-	-	NI	0.	0.	0.0	ND NF	1
B	House	BN PF	4.000	0.900	-	-	NI	150.	0.	0.0	ND NF	2
C	House	BN PF	4.000	0.900	-	-	NI	300.	0.	0.0	ND NF	3

S I T U A T I O N S :
P R E S E N C E F A C T O R S : Ref ex 8 Adm No: 1 Printed: 3 February 2020 /13:34:34 User Ref: CE

			1/N/O Night	2/D/O Day	3/E/O Evening	4/W/O Weekend	5/T/O Train
========= O b j e c t ==========		SD=	0.3750/ 1	0.2976/ 1	0.1488/ 1	0.1786/ 1	0.0000/ 0
Ref.	Name	Ident. TPW=	0.0/	0.0/	0.0/	0.0/	0.0/
A	House	1	1.000	0.250	0.750	0.750	0.250
B	House	2	1.000	0.250	0.750	0.750	0.250
C	House	3	1.000	0.250	0.750	0.750	0.250

Saved: 3 February 2020 /File Code: C:\AMRISK\ref_ex_8.amr /User name: Fortv Global X/Y: 0. 0.

A.8.1 Example 8.1: No barricade

T U N N E L:
D A T A: Ref ex 8 Adm No: 1 User Ref: CE

Tunnel: 1 1 ROCK ORIGINAL CH ORG-OPT

Chamber Entrance: Coordinates (X/Y): 100. / 400. Area Tunnel (m2): 20.00
Tunnel Exit: Coordinates (X/Y): 0. / 250. Area Tunnel (m2): 20.00
2. Point Tunnel Exit: Coordinates (X/Y): 0. / 270.
Debris Geometry: Type: Small Angles Length of Tunnel (m): 172.0

Data of Terrain Limitation (m)	Sector	1	2	3	4	5	6	7	8	9	10	11	12
	30.0 deg	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Vertical Angle	22.5 deg	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-
	15.0 deg	-	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-	
	7.5 deg	-	-	0.0	0.0	0.0	0.0	0.0	0.0			-	-
	5.0 deg	-	-	-	-	0.0	0.0	0.0	0.0	-	-	-	-

Element of Tunnel No	Type	Area F1 (m2)	Area F2 (m2)	Lining	Length (m)	Calculation Case	Angle (deg)	Pressure p2/p1	Duration t2/t1	Rema
1	Friction element	20.00	20.00	SHOTCRETE	10.0					
2	Junction, joining	20.00	20.00	SHOTCRETE		Main Case	90.0			
3	Friction element	20.00	20.00	SHOTCRETE	172.0					

A.8.2 Example 8.2: A barricade in front of one tunnel adit

T U N N E L D A T A: Ref ex 8 barr1 Adm No: 1 User Ref: CE

Tunnel: 1 1 ROCK ORIGINAL CH ORG-OPT

Chamber Entrance: Coordinates (X/Y): 100. 400. Area Tunnel (m2): 20.00
Tunnel Exit: Coordinates (X/Y): 0. 250. Area Tunnel (m2): 20.00
2. Point Tunnel Exit: Coordinates (X/Y): 0. 270.
Debris Geometry: Type: Small Angles Length of Tunnel (m): 172.0

Data of Terrain Limitation (m)	Sector	1	2	3	4	5	6	7	8	9	10	11	12
	30.0 deg	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
	Vertical 22.5 deg	-	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	-
	Angle 15.0 deg	-	-	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	-	
	7.5 deg	-	-	10.0	10.0	10.0	10.0	10.0	10.0			-	-
	5.0 deg	-	-	-	-	10.0	10.0	10.0	10.0	-	-	-	-

Element of Tunnel No	Type	Area F1 (m2)	Area F2 (m2)	Lining	Length (m)	Calculation Case	Angle (deg)	Pressure p2/p1	Duration t2/t1	Rema
1	Friction element	20.00	20.00	SHOTCRETE	10.0					
2	Junction, joining	20.00	20.00	SHOTCRETE		Main Case	90.0			
3	Friction element	20.00	20.00	SHOTCRETE	172.0					

A.8.3 Example 8.3: A barricade in front of each of the tunnel adits

T U N N E L D A T A: Ref ex 8 barr2 Adm No: 1 User Ref: CE

Tunnel: 1 1 ROCK ORIGINAL CH ORG-OPT

Chamber Entrance: Coordinates (X/Y): 100. 400. Area Tunnel (m2): 20.00
Tunnel Exit: Coordinates (X/Y): 0. 250. Area Tunnel (m2): 20.00
2. Point Tunnel Exit: Coordinates (X/Y): 0. 270.
Debris Geometry: Type: Small Angles Length of Tunnel (m): 172.0

Data of	Sector	1	2	3	4	5	6	7	8	9	10	11	12

Terrain Limitation (m)		Sector 1	2	3	4	5	6	7	8	9	10	11	12
	30.0 deg	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
Vertical	22.5 deg	-	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	-
Angle	15.0 deg	-	-	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	-	
	7.5 deg	-	-	10.0	10.0	10.0	10.0	10.0	10.0			-	-
	5.0 deg	-	-	-	-	10.0	10.0	10.0	10.0	-	-	-	-

Element of Tunnel No	Type	Area F1 (m2)	Area F2 (m2)	Lining	Length (m)	Calculation Case	Angle (deg)	Pressure p2/p1	Duration t2/t1	Rema
1	Friction element	20.00	20.00	SHOTCRETE	10.0					
2	Junction, joining	20.00	20.00	SHOTCRETE		Main Case	90.0			
3	Friction element	20.00	20.00	SHOTCRETE	172.0					

T U N N E L D A T A: Ref ex 8 barr2 Adm No: 1 User Ref: CE

Tunnel: 2 1 ROCK ORIGINAL CH ORG-OPT

Chamber Entrance: Coordinates (X/Y): 100. 400. Area Tunnel (m2): 20.00
Tunnel Exit: Coordinates (X/Y): 300. 250. Area Tunnel (m2): 20.00
2. Point Tunnel Exit: Coordinates (X/Y): 300. 270.
Debris Geometry: Type: Small Angles Length of Tunnel (m): 244.0

Data of Terrain Limitation (m)		Sector 1	2	3	4	5	6	7	8	9	10	11	12
	30.0 deg	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
Vertical	22.5 deg	-	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	-
Angle	15.0 deg	-	-	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	-	
	7.5 deg	-	-	10.0	10.0	10.0	10.0	10.0	10.0			-	-
	5.0 deg	-	-	-	-	10.0	10.0	10.0	10.0	-	-	-	-

Element of Tunnel No	Type	Area F1 (m2)	Area F2 (m2)	Lining	Length (m)	Calculation Case	Angle (deg)	Pressure p2/p1	Duration t2/t1	Rema
1	Friction element	20.00	20.00	SHOTCRETE	10.0					
2	Friction element	20.00	20.00	SHOTCRETE	10.0					
3	Friction element	20.00	20.00	SHOTCRETE	10.0					
4	Friction element	20.00	20.00	SHOTCRETE	10.0					
5	Friction element	20.00	20.00	SHOTCRETE	10.0					
6	Friction element	20.00	20.00	SHOTCRETE	10.0					
7	Friction element	20.00	20.00	SHOTCRETE	10.0					
8	Friction element	20.00	20.00	SHOTCRETE	10.0					
9	Friction element	20.00	20.00	SHOTCRETE	10.0					

10	Friction element	20.00	20.00	SHOTCRETE	10.0		
11	Friction element	20.00	20.00	SHOTCRETE	10.0		
12	Friction element	20.00	20.00	SHOTCRETE	10.0		
13	Friction element	20.00	20.00	SHOTCRETE	10.0		
14	Friction element	20.00	20.00	SHOTCRETE	10.0		
15	Friction element	20.00	20.00	SHOTCRETE	10.0		
16	Junction, joining	20.00	20.00	SHOTCRETE		Secondary Case	90.0
17	Friction element	20.00	20.00	SHOTCRETE	244.0		

A.9 Reference example 9

M A G A Z I N E / C H A M B E R :
D A T A: Ref ex 9 Adm No: 1 Printed: 3 February 2020 /13:36:38
User Ref: CE

Number: 1 Magazine name: 1 Type: ROCK ORIGINAL CH ORG-OPT

General Information: Name of Depot: Ref ex 9 Depot number: 1

Dimensions: Length (m): 60.0 Width (m): 20.0 Height (m): 5.0 Volume (m3): 6000.0

Cross section (m2): 100.0 Chamber exit area: 20.0

Cover: Earth (m): 0.0 Rock (m): 30.0

Type of Access: Longitudinal access

Chamber lining: SHOTCRETE

Coordinates: Centre x (m): 100.0 Centre y (m): 430.0 Altitude (m): 0.0
Axis x (m): 100.0 Axis y (m): 400.0

Crater: Crater x (m): 100.0 Crater y (m): 410.0 Altitude (m): 30.0
2.pt x (m): 100.0 2.pt y (m): 380.0 Altitude (m): 25.0

Number of charges: 1

Charge number: 1 NEQ: 100.00 Gross NEQ: 588.00 Probability 89.20 * 10E-6 Mix A assumed (mixed storage)

T U N N E L:
D A T A: Ref ex 9 Adm No: 1 Printed: 3 February 2020 /13:36:38
User Ref: CE

Tunnel: 1 1 ROCK ORIGINAL CH ORG-OPT

Chamber Entrance: Coordinates (X/Y): 100. / 400. Area Tunnel (m2): 20.00
Tunnel Exit: Coordinates (X/Y): 0. / 250. Area Tunnel (m2): 20.00
2. Point Tunnel Exit: Coordinates (X/Y): 0. / 270.
Debris Geometry: Type: Small Angles Length of Tunnel (m): 172.0

Data of Terrain Limitation (m)	Sector	1	2	3	4	5	6	7	8	9	10	11	12
	30.0 deg	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Vertical 22.5 deg	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-
	Angle 15.0 deg	-	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-	
	7.5 deg	-	-	0.0	0.0	0.0	0.0	0.0	0.0			-	-
	5.0 deg	-	-	-	-	0.0	0.0	0.0	0.0	-	-	-	-

Element of Tunnel No	Type	Area F1 (m2)	Area F2 (m2)	Lining	Length (m)	Calculation Case	Angle (deg)	Pressure p2/p1	Duration t2/t1	Rema
1	Friction element	20.00	20.00	SHOTCRETE	10.0					
2	Junction, joining	20.00	20.00	SHOTCRETE		Main Case	90.0			
3	Friction element	20.00	20.00	SHOTCRETE	172.0					

Tunnel: 2 1 ROCK ORIGINAL CH ORG-OPT

Chamber Entrance: Coordinates (X/Y): 100. / 400. Area Tunnel (m2): 20.00
Tunnel Exit: Coordinates (X/Y): 300. / 250. Area Tunnel (m2): 20.00
2. Point Tunnel Exit: Coordinates (X/Y): 300. / 270.
Debris Geometry: Type: Small Angles Length of Tunnel (m): 244.0

Data of Terrain Limitation (m)	Sector	1	2	3	4	5	6	7	8	9	10	11	12
	30.0 deg	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Vertical 22.5 deg	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-
	Angle 15.0 deg	-	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-	
	7.5 deg	-	-	0.0	0.0	0.0	0.0	0.0	0.0			-	-
	5.0 deg	-	-	-	-	0.0	0.0	0.0	0.0	-	-	-	-

Element of Tunnel No	Type	Area F1 (m2)	Area F2 (m2)	Lining	Length (m)	Calculation Case	Angle (deg)	Pressure p2/p1	Duration t2/t1	Rema

1	Friction element	20.00	20.00	SHOTCRETE	10.0	
2	Junction, joining	20.00	20.00	SHOTCRETE	Secondary Case	90.0
3	Friction element	20.00	20.00	SHOTCRETE	244.0	

M A G A Z I N E / C H A M B E R :
D A T A: Ref ex 9 Adm No: 1 Printed: 3 February 2020 /13:36:38 User Ref: CE

Number: 2 Magazine name: 2 Type: ROCK ORIGINAL CH ORG-OPT

General Information: Name of Depot: Ref ex 9 Depot number: 1

Dimensions:	Length (m):	60.0	Width (m):	20.0	Height (m):	5.0	Volume (m3): 6000.0
					Cross section (m2):	100.0	Chamber exit area: 20.0
Cover:	Earth (m):	0.0	Rock (m):	30.0			
Type of Access:	Longitudinal access						
Chamber lining:							
Coordinates:	Centre x (m):	200.0	Centre y (m):	430.0	Altitude (m):	0.0	
	Axis x (m):	200.0	Axis y (m):	400.0			
Crater:	Crater x (m):	200.0	Crater y (m):	410.0	Altitude (m):	30.0	
	2.pt x (m):	200.0	2.pt y (m):	380.0	Altitude (m):	25.0	

Number of charges: 1

Charge number: 1 NEQ: 100.00 Gross NEQ: 588.00 Probability 89.20 * 10E-6 Mix A assumed (mixed storage)

T U N N E L:
D A T A: Ref ex 9 Adm No: 1 Printed: 3 February 2020 /13:36:38 User Ref: CE

Tunnel: 1 2 ROCK ORIGINAL CH ORG-OPT

Chamber Entrance:	Coordinates (X/Y):	200. / 400.	Area Tunnel (m2):	20.00
Tunnel Exit:	Coordinates (X/Y):	0. / 250.	Area Tunnel (m2):	20.00
2. Point Tunnel Exit:	Coordinates (X/Y):	0. / 270.		
Debris Geometry:	Type: Small Angles	Length of Tunnel (m):	244.0	

Data of Terrain Limitation (m)	Sector	1	2	3	4	5	6	7	8	9	10	11	12
	30.0 deg	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

	Vertical	22.5 deg	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-
	Angle	15.0 deg	-	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-	
		7.5 deg	-	-	0.0	0.0	0.0	0.0	0.0	0.0			-	-
		5.0 deg	-	-	-	-	0.0	0.0	0.0	0.0	-	-	-	-

Element of Tunnel No	Type	Area F1 (m2)	Area F2 (m2)	Lining	Length (m)	Calculation Case	Angle (deg)	Pressure p2/p1	Duration t2/t1	Rema
1	Friction element	20.00	20.00	SHOTCRETE	10.0					
2	Junction, joining	20.00	20.00	SHOTCRETE		Main Case	90.0			
3	Friction element	20.00	20.00	SHOTCRETE	244.0					

T U N N E L:
D A T A: Ref ex 9 Adm No: 1

Printed: 3 February 2020 /13:36:38
User Ref: CE

Tunnel: 2 2 ROCK ORIGINAL CH ORG-OPT

Chamber Entrance: Coordinates (X/Y): 200. / 400. Area Tunnel (m2): 20.00
Tunnel Exit: Coordinates (X/Y): 300. / 250. Area Tunnel (m2): 20.00
2. Point Tunnel Exit: Coordinates (X/Y): 300. / 270.
Debris Geometry: Type: Small Angles Length of Tunnel (m): 172.0

Data of Terrain Limitation (m)	Sector		1	2	3	4	5	6	7	8	9	10	11	12
		30.0 deg	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Vertical	22.5 deg	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-
	Angle	15.0 deg	-	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-	
		7.5 deg	-	-	0.0	0.0	0.0	0.0	0.0	0.0			-	-
		5.0 deg	-	-	-	-	0.0	0.0	0.0	0.0	-	-	-	-

Element of Tunnel No	Type	Area F1 (m2)	Area F2 (m2)	Lining	Length (m)	Calculation Case	Angle (deg)	Pressure p2/p1	Duration t2/t1	Rema
1	Friction element	20.00	20.00	SHOTCRETE	10.0					
2	Junction, joining	20.00	20.00	SHOTCRETE		Secondary Case	90.0			
3	Friction element	20.00	20.00	SHOTCRETE	172.0					

E X P O S E D:
O B J E C T S: Ref ex 9 Adm No: 1 Printed: 3 February 2020 /13:36:38
User Ref: CE

Object Ref	Object Name	Exp./Calc. Type	PKZ/DTV	Tind	Ltrain or Width	Velocity (km/h)	Person Type	Coordinates X	Coordinates Y	Altitude	Danger	Object Ident
A	House	BN PF	4.000	0.900	-	-	NI	0.	0.	0.0	ND NF	1
B	House	BN PF	4.000	0.900	-	-	NI	150.	0.	0.0	ND NF	2
C	House	BN PF	4.000	0.900	-	-	NI	300.	0.	0.0	ND NF	3
D	Road	CR LR	2000.000	-	-	50.0	NI	400.	300.	0.0	ND NF	4
								300.	-700.	0.0	ND NF	
E	Train	TR LT	1.000	-	100.0	100.0	NI	-300.	300.	0.0	ND NF	5
								-150.	-800.	0.0	ND NF	
F	Cottage area	BN AL	4000.000	0.121	200.0	-	NI	-100.	-400.	0.0	ND NF	6
								-100.	-200.	0.0	ND NF	

S I T U A T I O N S :
P R E S E N C E F A C T O R S : Ref ex 9 Adm No: 1 Printed: 3 February 2020 /13:36:38
User Ref: CE

Ref.	Name	Ident.	1/N/O Night	2/D/O Day	3/E/O Evening	4/W/O Weekend	5/T/O Train
========= O b j e c t ==========		SD=	0.3750/ 1	0.2976/ 1	0.1488/ 1	0.1786/ 1	0.0000/ 1
		TPW=	0.0/	0.0/	0.0/	0.0/	60.0/ 5
A	House	1	1.000	0.250	0.750	0.750	0.250
B	House	2	1.000	0.250	0.750	0.750	0.250
C	House	3	1.000	0.250	0.750	0.750	0.250
D	Road	4	0.050	0.500	0.200	0.250	0.500
E	Train	5	0.000	0.000	0.000	0.000	1.000
F	Cottage area	6	0.135	0.101	0.135	0.101	0.101

A.10 Reference example 10

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M A G A Z I N E / C H A M B E R :                                                                    Printed:  3 February 2020 /14:30: 4
D A T A:                                  Ref ex 10                          Adm No: 1               User Ref: CE
-------------------------------------------------------------------------------------------------------------------------------------
Number:      1  Magazine name: 1                              Type:          ROCK ORIGINAL CH ORG-OPT
-------------------------------------------------------------------------------------------------------------------------------------

General Information:Name of Depot:  Ref ex 10                                Depot number:  1

Dimensions:         Length (m):       60.0     Width (m):       20.0        Height (m):            5.0          Volume (m3):      6000.0

                                                                            Cross section (m2):   100.0          Chamber exit area:  20.0

Cover:              Earth (m):         0.0     Rock (m):        30.0

Type of Access:     Longitudinal access

Chamber lining:     SHOTCRETE

Coordinates:        Centre x (m):    100.0     Centre y (m):   430.0        Altitude (m):          0.0
                    Axis x (m):      100.0     Axis y (m):     400.0

Crater:             Crater x (m):    100.0     Crater y (m):   410.0        Altitude (m):         30.0
                    2.pt x (m):      100.0     2.pt y (m):     380.0        Altitude (m):         25.0

Number of charges:   1

Charge number:       1   NEQ: 100.00    Gross NEQ:  588.00     Probability    89.20  * 10E-6                    Mix A assumed (mixed storage)

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T U N N E L:                                                                                         Printed:  3 February 2020 /14:30: 4
D A T A:                                  Ref ex 10                          Adm No: 1               User Ref: CE
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Tunnel:      1                                1                                  ROCK ORIGINAL CH ORG-OPT
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Chamber Entrance:            Coordinates (X/Y):      100. /    400.          Area Tunnel (m2):  20.00
Tunnel Exit:                 Coordinates (X/Y):        0. /    250.          Area Tunnel (m2):  20.00
2. Point Tunnel Exit:        Coordinates (X/Y):        0. /    270.
Debris Geometry:             Type: Small Angles         Length of Tunnel (m):  172.0

Data of                      Sector                    1       2       3       4       5       6       7       8       9      10      11      12
Terrain Limitation (m)       ------------------------------------------------------------------------------------------------------------------
                                        30.0 deg      0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
```

Vertical	22.5 deg	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-
Angle	15.0 deg	-	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-	
	7.5 deg	-	-	0.0	0.0	0.0	0.0	0.0	0.0			-	-
	5.0 deg	-	-	-	-	0.0	0.0	0.0	0.0	-	-	-	-

Element of Tunnel No	Type	Area F1 (m2)	Area F2 (m2)	Lining	Length (m)	Calculation Case	Angle (deg)	Pressure p2/p1	Duration t2/t1	Rema
1	Friction element	20.00	20.00	SHOTCRETE	10.0					
2	Junction, joining	20.00	20.00	SHOTCRETE		Main Case	90.0			
3	Friction element	20.00	20.00	SHOTCRETE	172.0					

T U N N E L: Printed: 3 February 2020 /14:30: 4
D A T A: Ref ex 10 Adm No: 1 User Ref: CE

Tunnel: 2 1 ROCK ORIGINAL CH ORG-OPT

Chamber Entrance: Coordinates (X/Y): 100. / 400. Area Tunnel (m2): 20.00
Tunnel Exit: Coordinates (X/Y): 300. / 250. Area Tunnel (m2): 20.00
2. Point Tunnel Exit: Coordinates (X/Y): 300. / 270.
Debris Geometry: Type: Small Angles Length of Tunnel (m): 244.0

Data of Terrain Limitation (m)	Sector	1	2	3	4	5	6	7	8	9	10	11	12
	30.0 deg	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Vertical	22.5 deg	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-
Angle	15.0 deg	-	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-	
	7.5 deg	-	-	0.0	0.0	0.0	0.0	0.0	0.0			-	-
	5.0 deg	-	-	-	-	0.0	0.0	0.0	0.0	-	-	-	-

Element of Tunnel No	Type	Area F1 (m2)	Area F2 (m2)	Lining	Length (m)	Calculation Case	Angle (deg)	Pressure p2/p1	Duration t2/t1	Rema
1	Friction element	20.00	20.00	SHOTCRETE	10.0					
2	Junction, joining	20.00	20.00	SHOTCRETE		Secondary Case	90.0			
3	Friction element	20.00	20.00	SHOTCRETE	244.0					

M A G A Z I N E / C H A M B E R : Printed: 3 February 2020 /14:30: 4
D A T A: Ref ex 10 Adm No: 1 User Ref: CE

Number: 2 Magazine name: 2 Type: ROCK ORIGINAL CH ORG-OPT

General Information: Name of Depot: Ref ex 10 Depot number: 1

Dimensions:	Length (m):	60.0	Width (m):	20.0	Height (m):	5.0	Volume (m3): 6000.0
					Cross section (m2):	100.0	Chamber exit area: 20.0
Cover:	Earth (m):	0.0	Rock (m):	30.0			
Type of Access:	Longitudinal access						
Chamber lining:							
Coordinates:	Centre x (m):	200.0	Centre y (m):	430.0	Altitude (m):	0.0	
	Axis x (m):	200.0	Axis y (m):	400.0			
Crater:	Crater x (m):	200.0	Crater y (m):	410.0	Altitude (m):	30.0	
	2.pt x (m):	200.0	2.pt y (m):	380.0	Altitude (m):	25.0	

Number of charges: 1

Charge number: 1 NEQ: 100.00 Gross NEQ: 588.00 Probability 89.20 * 10E-6 Mix A assumed (mixed storage)

Tunnel: 1 2 ROCK ORIGINAL CH ORG-OPT

Chamber Entrance:	Coordinates (X/Y):	200. / 400.	Area Tunnel (m2): 20.00
Tunnel Exit:	Coordinates (X/Y):	0. / 250.	Area Tunnel (m2): 20.00
2. Point Tunnel Exit:	Coordinates (X/Y):	0. / 270.	
Debris Geometry:	Type: Small Angles	Length of Tunnel (m): 244.0	

Data of Terrain Limitation (m)	Sector	1	2	3	4	5	6	7	8	9	10	11	12
	30.0 deg	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Vertical 22.5 deg	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-
	Angle 15.0 deg	-	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-	
	7.5 deg	-	-	0.0	0.0	0.0	0.0	0.0	0.0			-	-
	5.0 deg	-	-	-	-	0.0	0.0	0.0	0.0	-	-	-	-

Element of Tunnel	Area F1	Area F2	Lining	Length	Calcula-	Angle	Pressure	Duration	Rema

No	Type	(m2)	(m2)		(m)	tion Case	(deg)	p2/p1	t2/t1
1	Friction element	20.00	20.00	SHOTCRETE	10.0				
2	Junction, joining	20.00	20.00	SHOTCRETE		Main Case	90.0		
3	Friction element	20.00	20.00	SHOTCRETE	244.0				

T U N N E L: Printed: 3 February 2020 /14:30: 4
D A T A: Ref ex 10 Adm No: 1 User Ref: CE

Tunnel: 2 2 ROCK ORIGINAL CH ORG-OPT

Chamber Entrance: Coordinates (X/Y): 200. / 400. Area Tunnel (m2): 20.00
Tunnel Exit: Coordinates (X/Y): 300. / 250. Area Tunnel (m2): 20.00
2. Point Tunnel Exit: Coordinates (X/Y): 300. / 270.
Debris Geometry: Type: Small Angles Length of Tunnel (m): 172.0

Data of Terrain Limitation (m)	Sector	1	2	3	4	5	6	7	8	9	10	11	12
	30.0 deg	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Vertical Angle	22.5 deg	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-
	15.0 deg	-	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-	
	7.5 deg	-	-	0.0	0.0	0.0	0.0	0.0	0.0			-	-
	5.0 deg	-	-	-	-	0.0	0.0	0.0	0.0	-	-	-	-

Element of Tunnel No	Type	Area F1 (m2)	Area F2 (m2)	Lining	Length (m)	Calcula- tion Case	Angle (deg)	Pressure p2/p1	Duration t2/t1	Rema
1	Friction element	20.00	20.00	SHOTCRETE	10.0					
2	Junction, joining	20.00	20.00	SHOTCRETE		Secondary Case	90.0			
3	Friction element	20.00	20.00	SHOTCRETE	172.0					

E X P O S E D: Printed: 3 February 2020 /14:30: 4
O B J E C T S: Ref ex 10 Adm No: 1 User Ref: CE

Object Ref	Object Name	Exp./Calc. Type	PKZ/DTV	Tind	Ltrain or Width	Velocity (km/h)	Person Type	Coordinates X	Y	Altitude	Danger	Object Ident
A	House	BN PF	4.000	0.900	-	-	NI	0.	0.	0.0	ND NF	1

```
B          House                    BN PF     4.000      0.900          -           -          NI                                                                    2
                                                                                                          150.        0.          0.0     ND NF

C          House                    BN PF     4.000      0.900          -           -          NI                                                                    3
                                                                                                          300.        0.          0.0     ND NF

D          Path                     FF LF    10.000                                              NI                                                                    4
                                                                                                          400.      300.          0.0     ND NF
                                                                                                          300.     -700.          0.0     ND NF

E          People forest            FF AU     4.000       -           -           -          NI                                                                    5
```

```
S I T U A T I O N S :                                                                                                          Printed:  3 February 2020 /14:30: 4
P R E S E N C E   F A C T O R S :          Ref ex 10                                Adm No: 1                                  User Ref: CE
```

Ref.	Name	Ident.	1/N/O Night	2/D/O Day	3/E/O Evening	4/W/O Weekend
========= O b j e c t ==========		SD=	0.3750/ 1	0.2976/ 1	0.1488/ 1	0.1786/ 1
		TPW=	0.0/	0.0/	0.0/	0.0/
A	House	1	1.000	0.250	0.750	0.750
B	House	2	1.000	0.250	0.750	0.750
C	House	3	1.000	0.250	0.750	0.750
D	Path	4	0.000	0.300	0.300	0.400
E	People forest	5	0.000	0.250	0.500	0.750

```
Saved:  3 February 2020 /File Code: C:\AMRISK\ref_ex_10.amr                    /User name: Fortv                  Global X/Y:                  0.         0.
```

A.11 Reference example 11

```
M A G A Z I N E / C H A M B E R :                                                                                              Printed:  3 February 2020 /14:42:52
D A T A:                                  Ref ex 11                                Adm No: 1                                  User Ref: CE
```

```
Number:      1  Magazin name: 1                              Type:           ROCK ORIGINAL CH ORG-OPT
```

```
General Information:Name of Depot:  Ref ex 11                                Depot number:  1

Dimensions:         Length (m):       60.0     Width (m):       20.0        Height (m):            5.0          Volume (m3):      6000.0
```

Cross section (m2): 100.0 Chamber exit area: 20.0

Cover: Earth (m): 0.0 Rock (m): 30.0

Type of Access: Longitudinal access

Chamber lining: SHOTCRETE

Coordinates: Centre x (m): 100.0 Centre y (m): 430.0 Altitude (m): 0.0
Axis x (m): 100.0 Axis y (m): 400.0

Crater: Crater x (m): 100.0 Crater y (m): 410.0 Altitude (m): 30.0
2.pt x (m): 100.0 2.pt y (m): 380.0 Altitude (m): 25.0

Number of charges: 1

Charge number: 1 NEQ: 100.00 Gross NEQ: 588.00 Probability 89.20 * 10E-6 Mix A assumed (mixed storage)

T U N N E L: Printed: 3 February 2020 /14:42:52
D A T A: Ref ex 11 Adm No: 1 User Ref: CE

Tunnel: 1 1 ROCK ORIGINAL CH ORG-OPT

Chamber Entrance: Coordinates (X/Y): 100. / 400. Area Tunnel (m2): 20.00
Tunnel Exit: Coordinates (X/Y): 100. / 300. Area Tunnel (m2): 20.00
2. Point Tunnel Exit: Coordinates (X/Y): 100. / 320.
Debris Geometry: Type: Small Angles Length of Tunnel (m): 100.0

Data of Terrain Limitation (m)	Sector	1	2	3	4	5	6	7	8	9	10	11	12
	30.0 deg	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Vertical 22.5 deg	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-
	Angle 15.0 deg	-	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-	
	7.5 deg	-	-	0.0	0.0	0.0	0.0	0.0	0.0			-	-
	5.0 deg	-	-	-	-	0.0	0.0	0.0	0.0	-	-	-	-

Element of Tunnel No	Type	Area F1 (m2)	Area F2 (m2)	Lining	Length (m)	Calculation Case	Angle (deg)	Pressure p2/p1	Duration t2/t1	Rema
1	Friction element	20.00	20.00	SHOTCRETE	100.0					

M A G A Z I N E / C H A M B E R :
D A T A: Ref ex 11 Adm No: 1 Printed: 3 February 2020 /14:42:52
User Ref: CE

Number: 2 Magazine name: 2 Type: FREESTANDING MAGAZINE

General Information: Name of Depot: Ref ex 11 Depot number: 1

Dimensions: Length (m): 20.0 Width (m): 10.0 Height (m): 4.0 Volume (m3): 800.0

Type of Access: Longitudinal access

Debris masses: Building (t): 300.0

Coordinates: Centre x (m): 700.0 Centre y (m): -400.0 Altitude (m): 0.0
Axis x (m): 680.0 Axis y (m): -400.0

Number of charges: 1

Charge number: 1 NEQ: 100.00 Gross NEQ: 588.00 Probability 103.20 * 10E-6 Concrete freestanding magazine

E X P O S E D:
O B J E C T S: Ref ex 11 Adm No: 1 Printed: 3 February 2020 /14:42:52
User Ref: CE

Object Ref	Object Name	Exp./Calc. Type	PKZ/DTV	Tind	Ltrain or Width	Velocity (km/h)	Person Type	Coordinates X	Coordinates Y	Altitude	Danger	Object Ident
A	House	BN PF	4.000	0.900	-	-	NI					1
								200.	0.	0.0	ND NF	
B	Road	CR LR	2000.000	-	-	50.0	NI					2
								400.	300.	0.0	ND NF	
								300.	-700.	0.0	ND NF	
C	Train	TR LT	1.000	-	100.0	100.0	NI					3
								-300.	300.	0.0	ND NF	
								-150.	-800.	0.0	ND NF	
D	Cottage area	BN AL	4000.000	0.121	200.0	-	NI					4
								-100.	-400.	0.0	ND NF	
								-100.	-200.	0.0	ND NF	

S I T U A T I O N S :
P R E S E N C E F A C T O R S : Ref ex 11 Adm No: 1 Printed: 3 February 2020 /14:42:52
User Ref: CE

			1/N/O Night	2/D/O Day	3/E/O Evening	4/W/O Weekend	5/T/O Train
========= O b j e c t ==========		SD=	0.3750/ 1	0.2976/ 1	0.1488/ 1	0.1786/ 1	0.0000/ 1
Ref.	Name	Ident. TPW=	0.0/	0.0/	0.0/	0.0/	60.0/ 3
A	House	1	1.000	0.250	0.750	0.750	0.250
B	Road	2	0.050	0.500	0.200	0.250	0.500
C	Train	3	0.000	0.000	0.000	0.000	1.000
D	Cottage area	4	0.135	0.101	0.135	0.101	0.101

Saved: 3 February 2020 /File Code: C:\AMRISK\ref_ex_11.amr /User name: Fortv Global X/Y: 0. 0.

A.12 Reference example 12

M A G A Z I N E / C H A M B E R : Printed: 21 September2020 /13:46:01
D A T A: Ref ex 12 EC1 Adm No: 1 User Ref: CE

Number: 1 Magazine name: 1 Type: EARTH COVERED MAGAGINE

General Information: Name of Depot: Ref ex 12 EC1 Depot number: 1

Dimensions: Length (m): 20.0 Width (m): 10.0 Height (m): 4.0 Volume (m3): 800.0

Type of Access: Longitudinal access

Debris masses: Building (t): 300.0

Coordinates: Centre x (m): 0.0 Centre y (m): 0.0 Altitude (m): 0.0
Axis x (m): 50.0 Axis y (m): 0.0

Number of charges: 1

Charge number: 1 NEQ: 20.00 Gross NEQ: 117.65 Probability 32.65 * 10E-6 Mix A assumed (mixed storage)

E X P O S E D: Printed: 21 September 2020 /13:46:01
O B J E C T S: Ref ex 12 EC1 Adm No: 1 User Ref: CE

Object Ref	Object Name	Exp./Calc. Type	PKZ/DTV	Tind	Ltrain or Width	Velocity (km/h)	Person Type	Coordinates X	Coordinates Y	Altitude	Danger	Object Ident

A	House	BN PF	4.000	0.900	-	-	NI					1
								200.	0.	0.0	ND NF	
B	Road	CR LR	2000.000	-	-	50.0	NI					2
								400.	300.	0.0	ND NF	
								300.	-700.	0.0	ND NF	
C	Train	TR LT	1.000	-	100.0	100.0	NI					3
								-300.	300.	0.0	ND NF	
								-150.	-800.	0.0	ND NF	
D	Cottage area	BN AL	4000.000	0.121	200.0	-	NI					4
								-100.	-400.	0.0	ND NF	
								-100.	-200.	0.0	ND NF	

S I T U A T I O N S : Printed: 21 September2020 /13:46:01
P R E S E N C E F A C T O R S : Ref ex 12 EC1 Adm No: 1 User Ref: CE

			1/N/O Night	2/D/O Day	3/E/O Evening	4/W/O Weekend	5/T/O Train
========= O b j e c t ==========		SD=	0.3750/ 1	0.2976/ 1	0.1488/ 1	0.1786/ 1	0.0000/ 1
Ref.	Name	Ident. TPW=	0.0/	0.0/	0.0/	0.0/	60.0/ 3
A	House	1	1.000	0.250	0.750	0.750	0.250
B	Road	2	0.050	0.500	0.200	0.250	0.500
C	Train	3	0.000	0.000	0.000	0.000	1.000
D	Cottage area	4	0.135	0.101	0.135	0.101	0.101

Saved: 9 June 2020 /File Code: C:\AMRISK\ref_ex_12_EC1.amr /User name: Fortv Global X/Y: 0. 0.

A.13 Reference example 13

M A G A Z I N E / C H A M B E R : Printed: 21 September 2020 /14:02:28
D A T A: Ref ex 13 EC2 Adm No: 1 User Ref: ES

Number: 1 Magazine name: 1 Type: EARTH COVERED MAGAGINE

General Information:Name of Depot: Ref ex 13 EC2 Depot number: 1

Dimensions: Length (m): 20.0 Width (m): 10.0 Height (m): 4.0 Volume (m3): 800.0

Type of Access: Longitudinal access

Debris masses: Building (t): 300.0

Coordinates: Centre x (m): 0.0 Centre y (m): 0.0 Altitude (m): 0.0
Axis x (m): 50.0 Axis y (m): 0.0

Number of charges: 1

Charge number: 1 NEQ: 20.00 Gross NEQ: 117.65 Probability 32.65 * 10E-6 Mix A assumed (mixed storage)

E X P O S E D:
O B J E C T S: Ref ex 13 EC2 Adm No: 1 Printed: 21 September 2020 /14:02:28
User Ref: ES

Object Ref	Object Name	Exp./Calc. Type	PKZ/DTV	Tind	Ltrain or Width	Velocity (km/h)	Person Type	Coordinates X	Coordinates Y	Altitude	Danger	Object Ident
A	House	BN PF	4.000	0.900	-	-	NI	200.	0.	0.0	ND NF	1
B	Path	FF LF	10.000				NI	400.	300.	0.0	ND NF	2
								300.	-700.	0.0	ND NF	
C	People in forest	FF AU	4.000	-	-	-	NI					3

S I T U A T I O N S :
P R E S E N C E F A C T O R S : Ref ex 13 EC2 Adm No: 1 Printed: 21 September 2020 /14:02:28
User Ref: ES

Ref.	Name	Ident.	1/N/O Night	2/D/O Day	3/E/O Evening	4/W/O Weekend
========= O b j e c t ==========			SD= 0.3750/ 1	0.2976/ 1	0.1488/ 1	0.1786/ 1
			TPW= 0.0/	0.0/	0.0/	0.0/
A	House	1	1.000	0.250	0.750	0.750
B	Path	2	0.000	0.300	0.300	0.400
C	People in forest	3	0.000	0.250	0.500	0.750

A.14 Reference example 14

```
M A G A Z I N E / C H A M B E R :          ***NO PUBLICATION***IKKE OFFENTLIG***                    Printed: 29 April 2021 /15:55:41
D A T A:                                refex ug2                          Adm No:                 User Ref:
-------------------------------------------------------------------------------------------------------------------------------------
Number:      1  Magazin name: 01                          Type:           ROCK ACC FBT-NOTAT 179/85
-------------------------------------------------------------------------------------------------------------------------------------

General Information:Name of Depot:  refex ug2                                Depot number:

Dimensions:         Length (m):       68.4     Width (m):       16.3        Height (m):            9.7          Volume (m3):     10822.6
                                                                            Cross section (m2):   158.1          Chamber exit area:   9.9

Cover:              Earth (m):         2.0     Rock (m):        45.0

Type of Access:     Longitudinal access

Chamber lining:     CONCRETE

Coordinates:        Centre x (m):   1659.0     Centre y (m):  4258.0        Altitude (m):          4.0
                    Axis x (m):     1691.0     Axis y (m):    4282.0

Crater:             Crater x (m):   1711.0     Crater y (m):  4274.0        Altitude (m):         50.0
                    2.pt x (m):     1662.0     2.pt y (m):    4265.0        Altitude (m):         65.0

Two openings

Number of charges:   1

Charge number:       1   NEQ:  30.00    Gross NEQ:  176.47     Probability    27.47  * 10E-6                    Mix A assumed (mixed storage)

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T U N N E L:                               ***NO PUBLICATION***IKKE OFFENTLIG***                    Printed: 29 April    2021 /15:55:41
D A T A:                                refex ug2                          Adm No:                 User Ref:
-------------------------------------------------------------------------------------------------------------------------------------
Tunnel:      1                               01                                ROCK ACC FBT-NOTAT 179/85
-------------------------------------------------------------------------------------------------------------------------------------

Chamber Entrance:            Coordinates (X/Y):     1686. /   4279.           Area Tunnel (m2):   9.90
Tunnel Exit:                 Coordinates (X/Y):     1754. /   4295.           Area Tunnel (m2):   9.90
2. Point Tunnel Exit:        Coordinates (X/Y):     1730. /   4281.
Debris Geometry:             Type: Small Angles          Length of Tunnel (m):    5.0


Data of                      Sector                    1        2        3        4        5        6        7        8        9       10       11       12
```

Terrain Limitation (m)		Sector 1	2	3	4	5	6	7	8	9	10	11	12
		30.0 deg 0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Vertical	22.5 deg -	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-
	Angle	15.0 deg -	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-	
		7.5 deg -	-	0.0	0.0	0.0	0.0	0.0	0.0			-	-
		5.0 deg -	-	-	-	0.0	0.0	0.0	0.0	-	-	-	-

Element of Tunnel No	Type	Area F1 (m2)	Area F2 (m2)	Lining	Length (m)	Calculation Case	Angle (deg)	Pressure p2/p1	Duration t2/t1	Rema
1	Friction element	9.90	9.90	CONCRETE	4.0					
2	Expansion	9.90	25.00	ROCK	0.0					
3	Turn	25.00	25.00	ROCK			90.0			
4	Friction element	25.00	25.00	ROCK	150.0					
5	Blind tunnel	25.00	25.00	ROCK	15.0					
6	Constriction	25.00	9.90	CONCRETE	0.0					
7	Friction element	9.90	9.90	CONCRETE	5.0					

Tunnel: 2 01 ROCK ACC FBT-NOTAT 179/85

Chamber Entrance: Coordinates (X/Y): 1686. / 4279. Area Tunnel (m2): 9.90
Tunnel Exit: Coordinates (X/Y): 1754. / 4295. Area Tunnel (m2): 9.90
2. Point Tunnel Exit: Coordinates (X/Y): 1730. / 4281.
Debris Geometry: Type: Small Angles Length of Tunnel (m): 5.0

Data of Terrain Limitation (m)		Sector 1	2	3	4	5	6	7	8	9	10	11	12
		30.0 deg 0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Vertical	22.5 deg -	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-
	Angle	15.0 deg -	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-	
		7.5 deg -	-	0.0	0.0	0.0	0.0	0.0	0.0			-	-
		5.0 deg -	-	-	-	0.0	0.0	0.0	0.0	-	-	-	-

Element of Tunnel No	Type	Area F1 (m2)	Area F2 (m2)	Lining	Length (m)	Calculation Case	Angle (deg)	Pressure p2/p1	Duration t2/t1	Rema
1	Friction element	9.90	9.90	CONCRETE	4.0					
2	Expansion	9.90	25.00	ROCK	0.0					

3	Turn	25.00	25.00	ROCK		90.0
4	Friction element	25.00	25.00	ROCK	100.0	
5	Blind tunnel	25.00	25.00	ROCK	15.0	
6	Constriction	25.00	9.90	CONCRETE	0.0	
7	Friction element	9.90	9.90	ROCK	5.0	

E X P O S E D: ***NO PUBLICATION***IKKE OFFENTLIG*** Printed: 29 April 2021 /15:55:41
O B J E C T S: refex ug2 Adm No: User Ref:

Object Ref	Object Name	Exp./Calc. Type	PKZ/DTV	Tind	Ltrain or Width	Velocity (km/h)	Person Type	Coordinates X	Coordinates Y	Altitude	Danger	Object Ident
a1	Adm	BS PF	2.000	0.200	-	-	NI	1653.	4456.	0.0	ND NF	1
a2	verksted	BS PF	2.000	0.030	-	-	NI	1722.	4330.	0.0	ND NF	2
F1	Land	FF PF	1.000	0.100	-	-	NI	2114.	4485.	70.0	ND NF	3
v1	Båt	CR LR	20.000	-	-	10.0	NI	2284.	3792.	0.0	ND NF	4
								1765.	5026.	0.0	ND NF	

S I T U A T I O N S : ***NO PUBLICATION***IKKE OFFENTLIG*** Printed: 29 April 2021 /15:55:41
P R E S E N C E F A C T O R S : refex ug2 Adm No: User Ref:

Ref.	Name	Ident.	TPW=	1/ / day 0.0/	2/ / aften 0.0/	3/ / Night 0.0/	4/ / weekend 0.0/
	========= O b j e c t ==========		SD=	0.2000/ 1	0.3000/ 1	0.3000/ 1	0.2000/ 1
a1	Adm	1		1.000	0.010	0.000	0.000
a2	verksted	2		0.030	0.010	0.000	0.000
F1	Land	3		0.300	0.800	0.300	0.700
v1	Båt	4		0.300	0.800	0.300	0.700

B Results from reference tests

The results from the reference tests described in chapter 5.1, are shown in the tables below. If there are deviations between the results from AMRISK 2.0 and AMRISK 2.5, the numbers are in red colour.

B.1 Abbreviations

In the following tables, some abbreviations are not defined in chapter 5.1:

OKZ: Maximum expected consequence (number of fatalities) at an object (Objektkennzahl)
OO: Expected consequence at an object
OE: Expected consequence at an object including aversion

B.2 Reference example 2

PES

Freestanding magazine, Q = 20 t

EO

A. House (BN, PF)
B. Road (CR, LR)
C. Train (TR, LT)
D. Cottage area (BN, AL)

Table B.2.1 Results from reference example 2

Exposed object		Lethality	OKZ	OO	OE	Collective risk	Perceived collective risk	Individual risk
A: House	AMRISK 2.0	0.093	0.372	0.258	0.282	8.42×10^{-6}	9.20×10^{-6}	2.73×10^{-6}
	AMRISK 2.5	0.093	0.372	0.258	0.282	8.42×10^{-6}	9.20×10^{-6}	2.73×10^{-6}
B: Road	AMRISK 2.0	7.66×10^{-5}	0.153	0.0372	0.0399	1.21×10^{-6}	1.30×10^{-6}	
	AMRISK 2.5	7.66×10^{-5}	0.153	0.0372	0.0399	1.21×10^{-6}	1.30×10^{-6}	
C: Train	AMRISK 2.0	2.38	2.38	0.004	0.0059	1.31×10^{-7}	1.93×10^{-7}	
	AMRISK 2.5	2.38	2.38	0.004	0.0059	1.31×10^{-7}	1.93×10^{-7}	
D: Cottage area	AMRISK 2.0	0.0153	2.46	0.292	0.317	9.52×10^{-6}	1.04×10^{-5}	6.06×10^{-8}
	AMRISK 2.5	0.0153	2.46	0.292	0.317	9.52×10^{-6}	1.04×10^{-5}	6.06×10^{-8}
All objects	AMRISK 2.0					1.93×10^{-5}	2.11×10^{-5}	
	AMRISK 2.5					1.93×10^{-5}	2.11×10^{-5}	

B.3 Reference example 3

PES

Freestanding magazine, Q = 20 t

EO

A. House (BN, PF)
B. Path (FF, LF)
C. People in forest (FF, AU)

Table B.3.1 Results from reference example 3

Exposed object		Lethality	OKZ	OO	OE	Collective risk	Perceived collective risk	Individual risk
A: House	AMRISK 2.0	0.093	0.372	0.258	0.275	8.44×10^{-6}	8.99×10^{-6}	2.73×10^{-6}
	AMRISK 2.5	0.093	0.372	0.258	0.275	8.44×10^{-6}	8.99×10^{-6}	2.73×10^{-6}
B: Path	AMRISK 2.0	0.00782	0.0782	0.0161	0.0172	5.24×10^{-7}	5.61×10^{-7}	
	AMRISK 2.5	0.00782	0.0782	0.0161	0.0172	5.24×10^{-7}	5.61×10^{-7}	
C: People in forest	AMRISK 2.0	0.137	0.547	0.155	0.167	5.05×10^{-6}	5.46×10^{-6}	
	AMRISK 2.5	0.138	0.552	0.156	0.169	5.09×10^{-6}	5.51×10^{-6}	
All objects	AMRISK 2.0					1.40×10^{-5}	1.50×10^{-5}	
	AMRISK 2.5					1.40×10^{-5}	1.50×10^{-5}	

B.4 Reference example 4

PES

Two freestanding magazines:

Magazine 1, $Q = 20$ t

Magazine 2, $Q = 20$ t

EO

A. House (BN, PF)
B. Road (CR, LR)
C. Train (TR, LT)
D. Cottage area (BN, AL)

Table B.4.1 Consequence values from reference example 4

Exposed object		Lethality		OKZ		OO		OE	
		Mag. 1	Mag. 2	Mag. 1	Mag. 2	Mag. 1	Mag. 2	Mag. 1	Mag. 2
A: House	AMRISK 2.0	0.093	0.0496	0.372	0.199	0.258	0.138	0.297	0.245
	AMRISK 2.5	0.093	0.0496	0.372	0.199	0.258	0.138	0.297	0.245
B: Road	AMRISK 2.0	7.66×10^{-5}	9.37×10^{-5}	0.153	0.187	0.0372	0.0455	0.0452	0.083
	AMRISK 2.5	7.66×10^{-5}	9.37×10^{-5}	0.153	0.187	0.0372	0.0455	0.0452	0.083
C: Train	AMRISK 2.0	2.38	3.03	2.38	3.03	0.580	0.739	0.706	1.35
	AMRISK 2.5	2.38	3.03	2.38	3.03	0.580	0.739	0.706	1.35
D: Cottage area	AMRISK 2.0	0.0153	0.174	2.46	27.9	0.292	3.31	0.341	5.96
	AMRISK 2.5	0.0153	0.174	2.46	2.79	0.292	3.31	0.341	5.96

Table B.4.2 Risk values from reference example 4

Exposed object		Collective risk			Perceived collective risk			Individual risk		
		Mag. 1	Mag. 2	1 + 2	Mag. 1	Mag. 2	1 + 2	Mag. 1	Mag. 2	1 + 2
A: House	AMRISK 2.0	8.42×10^{-6}	4.49×10^{-6}	1.29×10^{-5}	9.71×10^{-6}	8.00×10^{-6}	1.77×10^{-5}	2.73×10^{-6}	1.46×10^{-6}	4.19×10^{-6}
	AMRISK 2.5	8.42×10^{-6}	4.49×10^{-6}	1.29×10^{-5}	9.71×10^{-6}	8.00×10^{-6}	1.77×10^{-5}	2.73×10^{-6}	1.46×10^{-6}	4.19×10^{-6}
B: Road	AMRISK 2.0	1.21×10^{-6}	1.48×10^{-6}	2.70×10^{-6}	1.48×10^{-6}	2.71×10^{-6}	4.18×10^{-6}			
	AMRISK 2.5	1.21×10^{-6}	1.48×10^{-6}	2.70×10^{-6}	1.48×10^{-6}	2.71×10^{-6}	4.18×10^{-6}			
C: Train	AMRISK 2.0	1.89×10^{-5}	2.41×10^{-5}	4.30×10^{-5}	2.31×10^{-5}	4.40×10^{-5}	6.70×10^{-5}			
	AMRISK 2.5	1.89×10^{-5}	2.41×10^{-5}	4.30×10^{-5}	2.31×10^{-5}	4.40×10^{-5}	6.70×10^{-5}			
D: Cottage area	AMRISK 2.0	9.52×10^{-6}	1.08×10^{-4}	1.17×10^{-4}	1.11×10^{-5}	1.94×10^{-4}	2.05×10^{-4}	6.06×10^{-8}	6.87×10^{-7}	7.48×10^{-7}
	AMRISK 2.5	9.52×10^{-6}	1.08×10^{-4}	1.17×10^{-4}	1.11×10^{-5}	1.94×10^{-4}	2.05×10^{-4}	6.06×10^{-8}	6.87×10^{-7}	7.48×10^{-7}
All objects	AMRISK 2.0	3.81×10^{-5}	1.38×10^{-4}	1.76×10^{-4}	4.54×10^{-5}	2.49×10^{-4}	2.94×10^{-4}			
	AMRISK 2.5	3.81×10^{-5}	1.38×10^{-4}	1.76×10^{-4}	4.54×10^{-5}	2.49×10^{-4}	2.94×10^{-4}			

B.5 Reference example 5

PES

Two freestanding magazines:

Magazine 1, Q = 20 t

Magazine 2, Q = 20 t

EO

A. House (BN, PF)
B. Path (FF, LF)
C. People in forest (FF, AU)

Table B.5.1 Consequence values from reference example 5

Exposed object		Lethality		OKZ		OO		OE	
		Mag. 1	Mag. 2	Mag. 1	Mag. 2	Mag. 1	Mag. 2	Mag. 1	Mag. 2
A: House	AMRISK 2.0	0.093	0.0496	0.372	0.199	0.258	0.138	0.275	0.144
	AMRISK 2.5	0.093	0.0496	0.372	0.199	0.258	0.138	0.275	0.144
B: Path	AMRISK 2.0	0.00782	0.00939	0.0782	0.0939	0.0161	0.0193	0.0172	0.0204
	AMRISK 2.5	0.00782	0.00939	0.0782	0.0939	0.0161	0.0193	0.0172	0.0204
C: People in forest	AMRISK 2.0	0.137	0.137	0.547	0.547	0.155	0.155	0.167	0.165
	AMRISK 2.5	0.138	0.138	0.552	0.552	0.156	0.156	0.169	0.166

Table B.5.2 Risk values from reference example 5

Exposed object		Collective risk			Perceived collective risk			Individual risk		
		Mag. 1	Mag. 2	1 + 2	Mag. 1	Mag. 2	1 + 2	Mag. 1	Mag. 2	1 + 2
A: House	AMRISK 2.0	8.43×10^{-6}	4.51×10^{-6}	1.29×10^{-5}	8.99×10^{-6}	4.71×10^{-6}	1.37×10^{-5}	2.73×10^{-6}	1.46×10^{-6}	4.19×10^{-6}
	AMRISK 2.5	8.43×10^{-6}	4.51×10^{-6}	1.29×10^{-5}	8.99×10^{-6}	4.71×10^{-6}	1.37×10^{-5}	2.73×10^{-6}	1.46×10^{-6}	4.19×10^{-6}
B: Path	AMRISK 2.0	5.24×10^{-7}	6.30×10^{-7}	1.15×10^{-6}	5.61×10^{-7}	6.66×10^{-7}	1.23×10^{-6}			
	AMRISK 2.5	5.24×10^{-7}	6.30×10^{-7}	1.15×10^{-6}	5.61×10^{-7}	6.66×10^{-7}	1.23×10^{-6}			
C: People in forest	AMRISK 2.0	5.05×10^{-6}	5.05×10^{-6}	1.01×10^{-5}	5.46×10^{-6}	5.38×10^{-6}	1.08×10^{-5}			
	AMRISK 2.5	5.09×10^{-6}	5.09×10^{-6}	1.02×10^{-5}	5.50×10^{-6}	5.43×10^{-6}	1.09×10^{-5}			
All objects	AMRISK 2.0	1.40×10^{-5}	1.02×10^{-5}	2.42×10^{-5}	1.50×10^{-5}	1.08×10^{-5}	2.58×10^{-5}			
	AMRISK 2.5	1.40×10^{-5}	1.02×10^{-5}	2.43×10^{-5}	1.50×10^{-5}	1.08×10^{-5}	2.59×10^{-5}			

B.6 Reference example 6

PES

Underground installation (UG1) with one chamber with $Q = 100$ t, one tunnel and adit (NO)

EO

A. House (BN, PF)
B. Road (CR, LR)
C. Train (TR, LT)
D. Cottage area (BN, AL)

Barricades

Example 6.1: No barricade

Example 6.2: One barricade, distance 10 m, elevation 30°

Example 6.3: One barricade, distance 10 m, elevation 15°

Example 6.4: One barricade, distance 20 m, elevation 30°

Table B.6.1 Results from reference example 6.1

Exposed object		Lethality	OKZ	OO	OE	Collective risk	Perceived collective risk	Ind. risk
A: House	AMRISK 2.0	0.252	1.01	0.698	0.836	6.23×10^{-5}	7.46×10^{-5}	2.02×10^{-5}
	AMRISK 2.5	0.252	1.01	0.698	0.836	6.23×10^{-5}	7.46×10^{-5}	2.02×10^{-5}
B: Road	AMRISK 2.0	2.13×10^{-4}	0.426	0.103	0.118	9.22×10^{-6}	1.06×10^{-5}	
	AMRISK 2.5	2.13×10^{-4}	0.426	0.103	0.118	9.22×10^{-6}	1.06×10^{-5}	
C: Train	AMRISK 2.0	0.215	0.215	3.08×10^{-4}	3.53×10^{-4}	2.74×10^{-8}	3.15×10^{-8}	
	AMRISK 2.5	0.215	0.215	3.08×10^{-4}	3.53×10^{-4}	2.74×10^{-8}	3.15×10^{-8}	
D: Cottage area	AMRISK 2.0	0.0197	3.16	0.375	0.444	3.34×10^{-5}	3.96×10^{-5}	2.13×10^{-7}
	AMRISK 2.5	0.0197	3.16	0.375	0.444	3.34×10^{-5}	3.96×10^{-5}	2.13×10^{-7}
All objects	AMRISK 2.0					1.05×10^{-4}	1.25×10^{-4}	
	AMRISK 2.5					1.05×10^{-4}	1.25×10^{-4}	

Table B.6.2 Results from reference example 6.2

Exposed object		Lethality	OKZ	OO	OE	Collective risk	Perceived collective risk	Ind. risk
A: House	AMRISK 2.0	0.165	0.659	0.457	0.506	4.08×10^{-5}	4.52×10^{-5}	1.32×10^{-5}
	AMRISK 2.5	0.165	0.659	0.457	0.506	4.08×10^{-5}	4.52×10^{-5}	1.32×10^{-5}
B: Road	AMRISK 2.0	1.06×10^{-4}	0.213	0.0517	0.0556	4.61×10^{-6}	4.96×10^{-6}	
	AMRISK 2.5	1.06×10^{-4}	0.213	0.0517	0.0556	4.61×10^{-6}	4.96×10^{-6}	

Exposed object		Lethality	OKZ	OO	OE	Collective risk	Perceived collective risk	Ind. risk
C: Train	AMRISK 2.0	0.0166	0.0166	3.70×10^{-5}	3.92×10^{-5}	3.3×10^{-9}	3.5×10^{-9}	
	AMRISK 2.5	0.0166	0.0166	3.70×10^{-5}	3.92×10^{-5}	3.3×10^{-9}	3.5×10^{-9}	
D: Cottage area	AMRISK 2.0	0.00772	1.23	0.147	0.161	1.31×10^{-5}	1.44×10^{-5}	8.32×10^{-8}
	AMRISK 2.5	0.00772	1.23	0.147	0.161	1.31×10^{-5}	1.44×10^{-5}	8.32×10^{-8}
All objects	AMRISK 2.0					5.85×10^{-5}	6.45×10^{-5}	
	AMRISK 2.5					5.85×10^{-5}	6.45×10^{-5}	

Table B.6.3 Results from reference example 6.3

Exposed object		Lethality	OKZ	OO	OE	Collective risk	Perceived collective risk	Ind. risk
A: House	AMRISK 2.0	0.00529	0.0212	0.0147	0.0149	1.31×10^{-6}	1.33×10^{-6}	4.25×10^{-7}
	AMRISK 2.5	0.00529	0.0212	0.0147	0.0149	1.31×10^{-6}	1.33×10^{-6}	4.25×10^{-7}
B: Road	AMRISK 2.0	4.20×10^{-5}	0.084	0.0204	0.0207	1.82×10^{-6}	1.84×10^{-6}	
	AMRISK 2.5	4.20×10^{-5}	0.084	0.0204	0.0207	1.82×10^{-6}	1.84×10^{-6}	
C: Train	AMRISK 2.0	0.192	0.192	2.75×10^{-4}	2.86×10^{-4}	2.45×10^{-8}	2.55×10^{-8}	
	AMRISK 2.5	0.192	0.192	2.75×10^{-4}	2.86×10^{-4}	2.45×10^{-8}	2.55×10^{-8}	
D: Cottage area	AMRISK 2.0	0.00338	0.54	0.0641	0.065	5.72×10^{-6}	5.80×10^{-6}	3.64×10^{-8}
	AMRISK 2.5	0.00338	0.54	0.0641	0.065	5.72×10^{-6}	5.80×10^{-6}	3.64×10^{-8}
All objects	AMRISK 2.0					8.87×10^{-6}	9.00×10^{-6}	
	AMRISK 2.5					8.87×10^{-6}	9.00×10^{-6}	

Table B.6.4 Results from reference example 6.4

Exposed object		Lethality	OKZ	OO	OE	Collective risk	Perceived collective risk	Ind. risk
A: House	AMRISK 2.0	9.31×10^{-5}	3.73×10^{-4}	2.58×10^{-4}	2.58×10^{-4}	2.31×10^{-8}	2.31×10^{-8}	7.48×10^{-9}
	AMRISK 2.5	9.31×10^{-5}	3.73×10^{-4}	2.58×10^{-4}	2.58×10^{-4}	2.31×10^{-8}	2.31×10^{-8}	7.48×10^{-9}
B: Road	AMRISK 2.0	2.26×10^{-6}	0.00452	0.00110	0.00110	9.79×10^{-8}	9.79×10^{-8}	
	AMRISK 2.5	2.26×10^{-6}	0.00452	0.00110	0.00110	9.79×10^{-8}	9.79×10^{-8}	
C: Train	AMRISK 2.0	0.0115	0.0115	1.88×10^{-5}	1.88×10^{-5}	1.67×10^{-9}	1.68×10^{-9}	
	AMRISK 2.5	0.0115	0.0115	1.88×10^{-5}	1.88×10^{-5}	1.67×10^{-9}	1.68×10^{-9}	
D: Cottage area	AMRISK 2.0	6.14×10^{-6}	9.82×10^{-4}	1.17×10^{-4}	1.17×10^{-4}	1.04×10^{-8}	1.04×10^{-8}	6.62×10^{-11}
	AMRISK 2.5	6.14×10^{-6}	9.82×10^{-4}	1.17×10^{-4}	1.17×10^{-4}	1.04×10^{-8}	1.04×10^{-8}	6.62×10^{-11}
All objects	AMRISK 2.0					1.33×10^{-7}	1.33×10^{-7}	
	AMRISK 2.5					1.33×10^{-7}	1.33×10^{-7}	

B.7 Reference example 7

PES

Underground installation (UG1) with one chamber with Q = 100 t, one tunnel and adit (NO)

EO

A. House (BN, PF)
B. Path (FF, LF)
C. People in forest (FF, AU)

Table B.7.1 Results from reference example 7

Exposed object		Lethality	OKZ	OO	OE	Collective risk	Perceived collective risk	Ind. risk
A: House	AMRISK 2.0	0.252	1.01	0.699	0.796	6.24×10^{-5}	7.10×10^{-5}	2.02×10^{-5}
	AMRISK 2.5	0.252	1.01	0.699	0.796	6.24×10^{-5}	7.10×10^{-5}	2.02×10^{-5}
B: Path	AMRISK 2.0	0.00249	0.0249	0.00511	0.00564	4.56×10^{-7}	5.03×10^{-7}	
	AMRISK 2.5	0.00249	0.0249	0.00511	0.00564	4.56×10^{-7}	5.03×10^{-7}	
C: People in forest	AMRISK 2.0	0.0869	0.348	0.0983	0.110	8.76×10^{-6}	9.83×10^{-6}	
	AMRISK 2.5	0.0868	0.347	0.0982	0.110	8.76×10^{-6}	9.83×10^{-6}	
All objects	AMRISK 2.0					7.16×10^{-5}	8.13×10^{-5}	
	AMRISK 2.5					7.16×10^{-5}	8.13×10^{-5}	

B.8 Reference example 8

PES

Underground installation (UG1) with two chambers, tunnel with different tunnel elements and two adits (NO)

Chamber 1, Q = 100 t
Chamber 2, Q = 100 t

EO

A. House (BN, PF)
B. House (BN, PF)
C. House (BN, PF)

Barricades

Example 8.1: No barricade

Example 8.2: A barricade in front of one tunnel adit, distance 10 m, elevation 30°

Example 8.3: A barricade in front of each of the tunnel adits, distance 10 m, elevation 30°

Table B.8.1 Consequence values from reference example 8.1

Exposed object		Lethality		OKZ		OO		OE	
		Chamber 1	Chamber 2	Chamber 1	Chamber 2	Chamber 1	Chamber 2	Chamber 1	Chamber 2
A: House	AMRISK 2.0	0.531	0.502	2.13	2.01	1.48	1.40	2.46	2.33
	AMRISK 2.5	0.531	0.502	2.13	2.01	1.48	1.40	2.46	2.33
B: House	AMRISK 2.0	0.0534	0.0534	0.214	0.214	0.148	0.148	0.247	0.247
	AMRISK 2.5	0.0534	0.0534	0.214	0.214	0.148	0.148	0.247	0.247
C: House	AMRISK 2.0	0.502	0.531	2.01	2.13	1.40	1.48	2.33	2.46
	AMRISK 2.5	0.502	0.531	2.01	2.13	1.40	1.48	2.33	2.46

Table B.8.2 Risk values from reference example 8.1

Exposed object		Collective risk			Perceived collective risk			Individual risk		
		Chamber 1	Chamber 2	1 + 2	Chamber 1	Chamber 2	1 + 2	Chamber 1	Chamber 2	1 + 2
A: House	AMRISK 2.0	1.32×10^{-4}	1.25×10^{-4}	2.56×10^{-4}	2.20×10^{-4}	2.07×10^{-4}	4.27×10^{-4}	4.27×10^{-5}	4.03×10^{-5}	8.30×10^{-5}
	AMRISK 2.5	1.32×10^{-4}	1.25×10^{-4}	2.56×10^{-4}	2.20×10^{-4}	2.07×10^{-4}	4.27×10^{-4}	4.27×10^{-5}	4.03×10^{-5}	8.30×10^{-5}
B: House	AMRISK 2.0	1.32×10^{-5}	1.32×10^{-5}	2.65×10^{-5}	2.21×10^{-5}	2.21×10^{-5}	4.41×10^{-5}	4.29×10^{-6}	4.29×10^{-6}	8.57×10^{-6}
	AMRISK 2.5	1.32×10^{-5}	1.32×10^{-5}	2.65×10^{-5}	2.21×10^{-5}	2.21×10^{-5}	4.41×10^{-5}	4.29×10^{-6}	4.29×10^{-6}	8.57×10^{-6}
C: House	AMRISK 2.0	1.25×10^{-4}	1.32×10^{-4}	2.56×10^{-4}	2.07×10^{-4}	2.20×10^{-4}	4.27×10^{-4}	4.03×10^{-5}	4.27×10^{-5}	8.30×10^{-5}
	AMRISK 2.5	1.25×10^{-4}	1.32×10^{-4}	2.56×10^{-4}	2.07×10^{-4}	2.20×10^{-4}	4.27×10^{-4}	4.03×10^{-5}	4.27×10^{-5}	8.30×10^{-5}
All objects	AMRISK 2.0	2.70×10^{-4}	2.70×10^{-4}	5.39×10^{-4}	4.49×10^{-4}	4.49×10^{-4}	8.98×10^{-4}			
	AMRISK 2.5	2.70×10^{-4}	2.70×10^{-4}	5.39×10^{-4}	4.49×10^{-4}	4.49×10^{-4}	8.98×10^{-4}			

Table B.8.3 Consequence values from reference example 8.2

Exposed object		Lethality		OKZ		OO		OE	
		Chamber 1	Chamber 2	Chamber 1	Chamber 2	Chamber 1	Chamber 2	Chamber 1	Chamber 2
A: House	AMRISK 2.0	0.126	0.502	0.502	2.01	0.349	1.4	0.48	2.33
	AMRISK 2.5	0.126	0.502	0.502	2.01	0.349	1.4	0.48	2.33
B: House	AMRISK 2.0	0.0534	0.0534	0.214	0.214	0.148	0.148	0.204	0.247
	AMRISK 2.5	0.0534	0.0534	0.214	0.214	0.148	0.148	0.204	0.247
C: House	AMRISK 2.0	0.502	0.531	2.01	2.13	1.4	1.48	1.92	2.46
	AMRISK 2.5	0.502	0.531	2.01	2.13	1.4	1.48	1.92	2.46

Table B.8.4 Risk values from reference example 8.2

Exposed object		Collective risk			Perceived collective risk			Individual risk		
		Chamber 1	Chamber 2	1 + 2	Chamber 1	Chamber 2	1 + 2	Chamber 1	Chamber 2	1 + 2
A: House	AMRISK 2.0	3.11×10^{-5}	1.25×10^{-4}	1.56×10^{-4}	4.28×10^{-5}	2.07×10^{-4}	2.50×10^{-4}	1.01×10^{-5}	4.03×10^{-5}	5.04×10^{-5}
	AMRISK 2.5	3.11×10^{-5}	1.25×10^{-4}	1.56×10^{-4}	4.28×10^{-5}	2.07×10^{-4}	2.50×10^{-4}	1.01×10^{-5}	4.03×10^{-5}	5.04×10^{-5}
B: House	AMRISK 2.0	1.32×10^{-5}	1.32×10^{-5}	2.65×10^{-5}	1.82×10^{-5}	2.21×10^{-5}	4.03×10^{-5}	4.29×10^{-6}	4.29×10^{-6}	8.57×10^{-6}
	AMRISK 2.5	1.32×10^{-5}	1.32×10^{-5}	2.65×10^{-5}	1.82×10^{-5}	2.21×10^{-5}	4.03×10^{-5}	4.29×10^{-6}	4.29×10^{-6}	8.57×10^{-6}
C: House	AMRISK 2.0	1.25×10^{-4}	1.32×10^{-4}	2.56×10^{-4}	1.71×10^{-4}	2.20×10^{-4}	3.91×10^{-4}	4.03×10^{-5}	4.27×10^{-5}	8.30×10^{-5}
	AMRISK 2.5	1.25×10^{-4}	1.32×10^{-4}	2.56×10^{-4}	1.71×10^{-4}	2.20×10^{-4}	3.91×10^{-4}	4.03×10^{-5}	4.27×10^{-5}	8.30×10^{-5}
All objects	AMRISK 2.0	1.69×10^{-4}	2.70×10^{-4}	4.38×10^{-4}	2.32×10^{-4}	4.49×10^{-4}	6.81×10^{-4}			
	AMRISK 2.5	1.69×10^{-4}	2.70×10^{-4}	4.38×10^{-4}	2.32×10^{-4}	4.49×10^{-4}	6.81×10^{-4}			

Table B.8.5 Consequence values from reference example 8.3

Exposed object		Lethality		OKZ		OO		OE	
		Chamber 1	Chamber 2	Chamber 1	Chamber 2	Chamber 1	Chamber 2	Chamber 1	Chamber 2
A: House	AMRISK 2.0	0.126	0.502	0.502	2.01	0.349	1.40	0.392	2.33
	AMRISK 2.5	0.126	0.502	0.502	2.01	0.349	1.40	0.392	2.33

Exposed object		Lethality		OKZ		OO		OE	
		Chamber 1	Chamber 2	Chamber 1	Chamber 2	Chamber 1	Chamber 2	Chamber 1	Chamber 2
B: House	AMRISK 2.0	0.0534	0.0534	0.214	0.214	0.148	0.148	0.167	0.247
	AMRISK 2.5	0.0534	0.0534	0.214	0.214	0.148	0.148	0.167	0.247
C: House	AMRISK 2.0	0.0711	0.531	0.285	2.13	0.198	1.48	0.222	2.46
	AMRISK 2.5	0.0711	0.531	0.285	2.13	0.198	1.48	0.222	2.46

Table B.8.6 Risk values from reference example 8.3

Exposed object		Collective risk			Perceived collective risk			Individual risk		
		Chamber 1	Chamber 2	1 + 2	Chamber 1	Chamber 2	1 + 2	Chamber 1	Chamber 2	1 + 2
A: House	AMRISK 2.0	3.11×10^{-5}	1.25×10^{-4}	1.56×10^{-4}	3.50×10^{-5}	2.07×10^{-4}	2.42×10^{-4}	1.01×10^{-5}	4.03×10^{-5}	5.04×10^{-5}
	AMRISK 2.5	3.11×10^{-5}	1.25×10^{-4}	1.56×10^{-4}	3.50×10^{-5}	2.07×10^{-4}	2.42×10^{-4}	1.01×10^{-5}	4.03×10^{-5}	5.04×10^{-5}
B: House	AMRISK 2.0	1.32×10^{-5}	1.32×10^{-5}	2.65×10^{-5}	1.49×10^{-5}	2.21×10^{-5}	3.69×10^{-5}	4.29×10^{-6}	4.29×10^{-6}	8.57×10^{-6}
	AMRISK 2.5	1.32×10^{-5}	1.32×10^{-5}	2.65×10^{-5}	1.49×10^{-5}	2.21×10^{-5}	3.69×10^{-5}	4.29×10^{-6}	4.29×10^{-6}	8.57×10^{-6}
C: House	AMRISK 2.0	1.76×10^{-5}	1.32×10^{-4}	1.49×10^{-4}	1.98×10^{-5}	2.20×10^{-4}	2.39×10^{-4}	5.71×10^{-6}	4.27×10^{-5}	4.84×10^{-5}
	AMRISK 2.5	1.76×10^{-5}	1.32×10^{-4}	1.49×10^{-4}	1.98×10^{-5}	2.20×10^{-4}	2.39×10^{-4}	5.71×10^{-6}	4.27×10^{-5}	4.84×10^{-5}
All objects	AMRISK 2.0	6.20×10^{-5}	2.70×10^{-4}	3.32×10^{-4}	6.96×10^{-5}	4.49×10^{-4}	5.19×10^{-4}			
	AMRISK 2.5	6.20×10^{-5}	2.70×10^{-4}	3.32×10^{-4}	6.96×10^{-5}	4.49×10^{-4}	5.19×10^{-4}			

B.9 Reference example 9

PES

Underground installation (UG1) with two chambers, tunnel with different tunnel elements and two adits (NO)

Chamber 1, Q = 100 t

Chamber 2, Q = 100 t

EO

A. House (BN, PF)
B. House (BN, PF)
C. House (BN, PF)
D. Road (CR, LR)
E. Train (TR, LT)
F. Cottage area (BN, AL)

Table B.9.1 Consequence values from reference example 9

Exposed object		Lethality		OKZ		OO		OE	
		Chamber 1	Chamber 2	Chamber 1	Chamber 2	Chamber 1	Chamber 2	Chamber 1	Chamber 2
A: House	AMRISK 2.0	0.531	0.502	2.13	2.01	1.47	1.39	2.88	2.77
	AMRISK 2.5	0.531	0.502	2.13	2.01	1.47	1.39	2.88	2.77
B: House	AMRISK 2.0	0.0534	0.0534	0.214	0.214	0.148	0.148	0.29	0.294
	AMRISK 2.5	0.0534	0.0534	0.214	0.214	0.148	0.148	0.29	0.294
C: House	AMRISK 2.0	0.502	0.531	2.01	2.13	1.39	1.47	2.72	2.93
	AMRISK 2.5	0.502	0.531	2.01	2.13	1.39	1.47	2.72	2.93
D: Road	AMRISK 2.0	0.00325	0.00367	6.51	7.34	1.58	1.78	3.01	3.54
	AMRISK 2.5	0.00325	0.00367	6.51	7.34	1.58	1.78	3.01	3.54
E: Train	AMRISK 2.0	0.338	0.332	0.338	0.332	6.40×10^{-4}	6.30×10^{-4}	0.00125	0.0013
	AMRISK 2.5	0.338	0.332	0.338	0.332	6.40×10^{-4}	6.30×10^{-4}	0.00125	0.0013
F: Cottage area	AMRISK 2.0	0.00865	0.00787	1.38	1.26	0.164	0.15	0.318	0.297
	AMRISK 2.5	0.00865	0.00787	1.38	1.26	0.164	0.15	0.318	0.297

Table B.9.2 Risk values from reference example 9

Exposed object		Collective risk			Perceived collective risk			Individual risk		
		Chamber 1	Chamber 2	1 + 2	Chamber 1	Chamber 2	1 + 2	Chamber 1	Chamber 2	1 + 2
A: House	AMRISK 2.0	1.32×10^{-4}	1.24×10^{-4}	2.56×10^{-4}	2.57×10^{-4}	2.47×10^{-4}	5.04×10^{-4}	4.27×10^{-5}	4.03×10^{-5}	8.30×10^{-5}
	AMRISK 2.5	1.32×10^{-4}	1.24×10^{-4}	2.56×10^{-4}	2.57×10^{-4}	2.47×10^{-4}	5.04×10^{-4}	4.27×10^{-5}	4.03×10^{-5}	8.30×10^{-5}
B: House	AMRISK 2.0	1.32×10^{-5}	1.32×10^{-5}	2.64×10^{-5}	2.58×10^{-5}	2.63×10^{-5}	5.21×10^{-5}	4.29×10^{-6}	4.29×10^{-6}	8.57×10^{-6}
	AMRISK 2.5	1.32×10^{-5}	1.32×10^{-5}	2.64×10^{-5}	2.58×10^{-5}	2.63×10^{-5}	5.21×10^{-5}	4.29×10^{-6}	4.29×10^{-6}	8.57×10^{-6}
C: House	AMRISK 2.0	1.24×10^{-4}	1.32×10^{-4}	2.56×10^{-4}	2.43×10^{-4}	2.61×10^{-4}	5.04×10^{-4}	4.03×10^{-5}	4.27×10^{-5}	8.30×10^{-5}
	AMRISK 2.5	1.24×10^{-4}	1.32×10^{-4}	2.56×10^{-4}	2.43×10^{-4}	2.61×10^{-4}	5.04×10^{-4}	4.03×10^{-5}	4.27×10^{-5}	8.30×10^{-5}
D: Road	AMRISK 2.0	1.41×10^{-4}	1.59×10^{-4}	3.00×10^{-4}	2.68×10^{-4}	3.16×10^{-4}	5.84×10^{-4}			
	AMRISK 2.5	1.41×10^{-4}	1.59×10^{-4}	3.00×10^{-4}	2.68×10^{-4}	3.16×10^{-4}	5.84×10^{-4}			
E: Train	AMRISK 2.0	5.71×10^{-8}	5.62×10^{-8}	1.13×10^{-7}	1.11×10^{-7}	1.16×10^{-7}	2.27×10^{-7}			
	AMRISK 2.5	5.71×10^{-8}	5.62×10^{-8}	1.13×10^{-7}	1.11×10^{-7}	1.16×10^{-7}	2.27×10^{-7}			
F: Cottage area	AMRISK 2.0	1.47×10^{-5}	1.33×10^{-5}	2.80×10^{-5}	2.84×10^{-5}	2.65×10^{-5}	5.49×10^{-5}	9.33×10^{-8}	8.50×10^{-8}	1.78×10^{-7}
	AMRISK 2.5	1.47×10^{-5}	1.33×10^{-5}	2.80×10^{-5}	2.84×10^{-5}	2.65×10^{-5}	5.49×10^{-5}	9.33×10^{-8}	8.50×10^{-8}	1.78×10^{-7}
All objects	AMRISK 2.0	4.25×10^{-4}	4.41×10^{-4}	8.66×10^{-4}	8.23×10^{-4}	8.77×10^{-4}	0.0017			
	AMRISK 2.5	4.25×10^{-4}	4.41×10^{-4}	8.66×10^{-4}	8.23×10^{-4}	8.77×10^{-4}	0.0017			

B.10 Reference example 10

PES

Underground installation (UG1) with two chambers, tunnel with different tunnel elements and two adits (NO)

Chamber 1, Q = 100 t
Chamber 2, Q = 100 t

EO

A. House (BN, PF)

B. House (BN, PF)
C. House (BN, PF)
D. Path (FF, LF)
E. People in forest (FF, AU)

Table B.10.1 Consequence values from reference example 10

Exposed object		Lethality		OKZ		OO		OE	
		Chamber 1	Chamber 2	Chamber 1	Chamber 2	Chamber 1	Chamber 2	Chamber 1	Chamber 2
A: House	AMRISK 2.0	0.531	0.502	2.13	2.01	1.48	1.40	2.55	2.42
	AMRISK 2.5	0.531	0.502	2.13	2.01	1.48	1.40	2.55	2.42
B: House	AMRISK 2.0	0.0534	0.0534	0.214	0.214	0.148	0.148	0.257	0.257
	AMRISK 2.5	0.0534	0.0534	0.214	0.214	0.148	0.148	0.257	0.257
C: House	AMRISK 2.0	0.502	0.531	2.01	2.13	1.40	1.48	2.41	2.56
	AMRISK 2.5	0.502	0.531	2.01	2.13	1.40	1.48	2.41	2.56
D: Path	AMRISK 2.0	0.110	0.112	1.10	1.12	0.226	0.230	0.342	0.349
	AMRISK 2.5	0.110	0.112	1.10	1.12	0.226	0.230	0.342	0.349
E: People in forest	AMRISK 2.0	0.117	0.117	0.467	0.467	0.132	0.132	0.212	0.212
	AMRISK 2.5	0.114	0.114	0.456	0.456	0.129	0.129	0.207	0.207

Table B.10.2 Risk values from reference example 10

Exposed object		Collective risk			Perceived collective risk			Individual risk		
		Chamber 1	Chamber 2	1 + 2	Chamber 1	Chamber 2	1 + 2	Chamber 1	Chamber 2	1 + 2
A: House	AMRISK 2.0	1.32×10^{-4}	1.25×10^{-4}	2.56×10^{-4}	2.28×10^{-4}	2.15×10^{-4}	4.43E+04	4.27×10^{-5}	4.03×10^{-5}	8.30×10^{-5}
	AMRISK 2.5	1.32×10^{-4}	1.25×10^{-4}	2.56×10^{-4}	2.28×10^{-4}	2.15×10^{-4}	4.43E+04	4.27×10^{-5}	4.03×10^{-5}	8.30×10^{-5}
B: House	AMRISK 2.0	1.32×10^{-5}	1.32×10^{-5}	2.65×10^{-5}	2.29×10^{-5}	2.29×10^{-5}	4.58×10^{-5}	4.29×10^{-6}	4.29×10^{-6}	8.57×10^{-6}
	AMRISK 2.5	1.32×10^{-5}	1.32×10^{-5}	2.65×10^{-5}	2.29×10^{-5}	2.29×10^{-5}	4.58×10^{-5}	4.29×10^{-6}	4.29×10^{-6}	8.57×10^{-6}

Exposed object		Collective risk			Perceived collective risk			Individual risk		
		Chamber 1	Chamber 2	1 + 2	Chamber 1	Chamber 2	1 + 2	Chamber 1	Chamber 2	1 + 2
C: House	AMRISK 2.0	1.25×10^{-4}	1.32×10^{-4}	2.56×10^{-4}	2.15×10^{-4}	2.28×10^{-4}	4.43×10^{-4}	4.03×10^{-5}	4.27×10^{-5}	8.30×10^{-5}
	AMRISK 2.5	1.25×10^{-4}	1.32×10^{-4}	2.56×10^{-4}	2.15×10^{-4}	2.28×10^{-4}	4.43×10^{-4}	4.03×10^{-5}	4.27×10^{-5}	8.30×10^{-5}
D: Path	AMRISK 2.0	2.01×10^{-5}	2.05×10^{-5}	4.06×10^{-5}	3.05×10^{-5}	3.11×10^{-5}	6.17×10^{-5}			
	AMRISK 2.5	2.01×10^{-5}	2.05×10^{-5}	4.06×10^{-5}	3.05×10^{-5}	3.11×10^{-5}	6.16×10^{-5}			
E: People in forest	AMRISK 2.0	1.18×10^{-5}	1.18×10^{-5}	2.36×10^{-5}	1.89×10^{-5}	1.89×10^{-5}	3.78×10^{-5}			
	AMRISK 2.5	1.15×10^{-5}	1.15×10^{-5}	2.30×10^{-5}	1.84×10^{-5}	1.84×10^{-5}	3.69×10^{-5}			
All objects	AMRISK 2.0	3.01×10^{-4}	3.02×10^{-4}	6.03×10^{-4}	5.16×10^{-4}	5.16×10^{-4}	0.00103			
	AMRISK 2.5	3.01×10^{-4}	3.02×10^{-4}	6.03×10^{-4}	5.15×10^{-4}	5.16×10^{-4}	0.00103			

B.11 Reference example 11

PES

Magazine 1: Underground installation (UG1) with one chamber with Q = 100 t, one tunnel and adit (NO)

Magazine 2: Freestanding, Q = 100 t

EO

A. House (BN, PF)
B. Road (CR, LR)
C. Train (TR, LT)
D. Cottage area (BN, AL)

Table B.11.1 Consequence values from reference example 11

Exposed object		Lethality		OKZ		OO		OE	
		Mag. 1	Mag. 2	Mag. 1	Mag. 2	Mag. 1	Mag. 2	Mag. 1	Mag. 2
A: House	AMRISK 2.0	0.252	0.00162	1.01	0.00649	0.698	0.0045	0.836	0.00495
	AMRISK 2.5	0.252	0.00162	1.01	0.00649	0.698	0.0045	0.836	0.00495
B: Road	AMRISK 2.0	2.13×10^{-4}	0.00198	0.426	3.95	0.103	0.961	0.118	1.19
	AMRISK 2.5	2.13×10^{-4}	0.00198	0.426	3.95	0.103	0.961	0.118	1.19
C: Train	AMRISK 2.0	0.215	0.0121	0.215	0.0121	3.08×10^{-4}	3.4×10^{-5}	3.53×10^{-4}	4.5×10^{-5}
	AMRISK 2.5	0.215	0.0121	0.215	0.0121	3.08×10^{-4}	3.4×10^{-5}	3.53×10^{-4}	4.5×10^{-5}
D: Cottage area	AMRISK 2.0	0.0197	9.76×10^{-4}	3.16	0.156	0.375	0.0185	0.444	0.0211
	AMRISK 2.5	0.0197	9.76×10^{-4}	3.16	0.156	0.375	0.0185	0.444	0.0211

Table B.11.2 Risk values from reference example 11

Exposed object		Collective risk			Perceived collective risk			Individual risk		
		Mag. 1	Mag. 2	1 + 2	Mag. 1	Mag. 2	1 + 2	Mag. 1	Mag. 2	1 + 2
A: House	AMRISK 2.0	6.23×10^{-5}	4.64×10^{-7}	6.27×10^{-5}	7.46×10^{-5}	5.11×10^{-7}	7.51×10^{-5}	2.02×10^{-5}	1.51×10^{-7}	2.03×10^{-5}
	AMRISK 2.5	6.23×10^{-5}	4.64×10^{-7}	6.27×10^{-5}	7.46×10^{-5}	5.11×10^{-7}	7.51×10^{-5}	2.02×10^{-5}	1.51×10^{-7}	2.03×10^{-5}
B: Road	AMRISK 2.0	9.22×10^{-6}	9.92×10^{-5}	1.08×10^{-4}	1.06×10^{-5}	1.23×10^{-4}	1.34×10^{-4}			
	AMRISK 2.5	9.22×10^{-6}	9.92×10^{-5}	1.08×10^{-4}	1.06×10^{-5}	1.23×10^{-4}	1.34×10^{-4}			
C: Train	AMRISK 2.0	2.74×10^{-8}	3.52×10^{-9}	3.10×10^{-8}	3.15×10^{-8}	4.64×10^{-9}	3.62×10^{-8}			
	AMRISK 2.5	2.74×10^{-8}	3.52×10^{-9}	3.10×10^{-8}	3.15×10^{-8}	4.64×10^{-9}	3.62×10^{-8}			
D: Cottage area	AMRISK 2.0	3.34×10^{-5}	1.91×10^{-6}	3.54×10^{-5}	3.96×10^{-5}	2.18×10^{-6}	4.18×10^{-5}	2.13×10^{-7}	1.22×10^{-8}	2.25×10^{-7}
	AMRISK 2.5	3.34×10^{-5}	1.91×10^{-6}	3.54×10^{-5}	3.96×10^{-5}	2.18×10^{-6}	4.18×10^{-5}	2.13×10^{-7}	1.22×10^{-8}	2.25×10^{-7}
All objects	AMRISK 2.0	1.05×10^{-4}	1.02×10^{-4}	2.07×10^{-4}	1.25×10^{-4}	1.26×10^{-4}	2.51×10^{-4}			
	AMRISK 2.5	1.05×10^{-4}	1.02×10^{-4}	2.07×10^{-4}	1.25×10^{-4}	1.26×10^{-4}	2.51×10^{-4}			

B.12 Reference example 12

PES

Earth-covered magazine, Q = 20 t

EO

A. House (BN, PF)
B. Road (CR, LR)
C. Train (TR, LT)
D. Cottage area (BN, AL)

Table B.12.1 Results from reference example 12

Exposed object		Lethality	OKZ	OO	OE	Collective risk	Perceived collective risk	Individual risk
A: House	AMRISK 2.0	0.0995	0.398	0.276	0.311	9.01×10^{-6}	1.02×10^{-5}	2.92×10^{-6}
	AMRISK 2.5	0.0995	0.398	0.276	0.311	9.01×10^{-6}	1.02×10^{-5}	2.92×10^{-6}
B: Road	AMRISK 2.0	3.67×10^{-4}	0.734	0.178	0.2	5.82×10^{-6}	6.55×10^{-6}	
	AMRISK 2.5	3.67×10^{-4}	0.734	0.178	0.2	5.82×10^{-6}	6.55×10^{-6}	
C: Train	AMRISK 2.0	5.16	5.16	0.0104	0.0237	3.39×10^{-7}	7.74×10^{-7}	
	AMRISK 2.5	5.16	5.16	0.0104	0.0237	3.39×10^{-7}	7.74×10^{-7}	
D: Cottage area	AMRISK 2.0	0.0206	3.3	0.392	0.442	1.28×10^{-5}	1.44×10^{-5}	8.15×10^{-8}
	AMRISK 2.5	0.0206	3.3	0.392	0.442	1.28×10^{-5}	1.44×10^{-5}	8.15×10^{-8}
All objects	AMRISK 2.0					2.80×10^{-5}	3.19×10^{-5}	
	AMRISK 2.5					2.80×10^{-5}	3.19×10^{-5}	

B.13 Reference example 13

PES

Earth-covered magazine, Q = 20 t

EO

A. House (BN, PF)
B. Path (FF, LF)
C. People in forest (FF, AU)

Table B.13.1 Results from reference example 13

Exposed object		Lethality	OKZ	OO	OE	Collective risk	Perceived collective risk	Individual risk
A: House	AMRISK 2.0	0.0995	0.398	0.277	0.3	9.03×10^{-6}	9.80×10^{-6}	2.92×10^{-6}
	AMRISK 2.5	0.0995	0.398	0.277	0.3	9.03×10^{-6}	9.80×10^{-6}	2.92×10^{-6}
B: Path	AMRISK 2.0	0.0333	0.333	0.0685	0.0756	2.23×10^{-6}	2.47×10^{-6}	
	AMRISK 2.5	0.0333	0.333	0.0685	0.0756	2.23×10^{-6}	2.47×10^{-6}	
C: People in forest	AMRISK 2.0	0.205	0.819	0.231	0.259	7.56×10^{-6}	8.47×10^{-6}	
	AMRISK 2.5	0.206	0.822	0.233	0.261	7.59×10^{-6}	8.51×10^{-6}	
All objects	AMRISK 2.0					1.88×10^{-5}	2.07×10^{-5}	
	AMRISK 2.5					1.89×10^{-5}	2.08×10^{-5}	

B.14 Reference example 14

PES

Underground installation (UG2) with one chamber with Q = 20 t, two tunnels and one adit (NO)

EO

a1. House (adm) (BS, PF)

a2. House (verksted) (BS, PF)

F1. Area (land) (FF, PF)

v1. Waterway (båt) (CR, LR)

Table B.14.1 Results from reference example 14

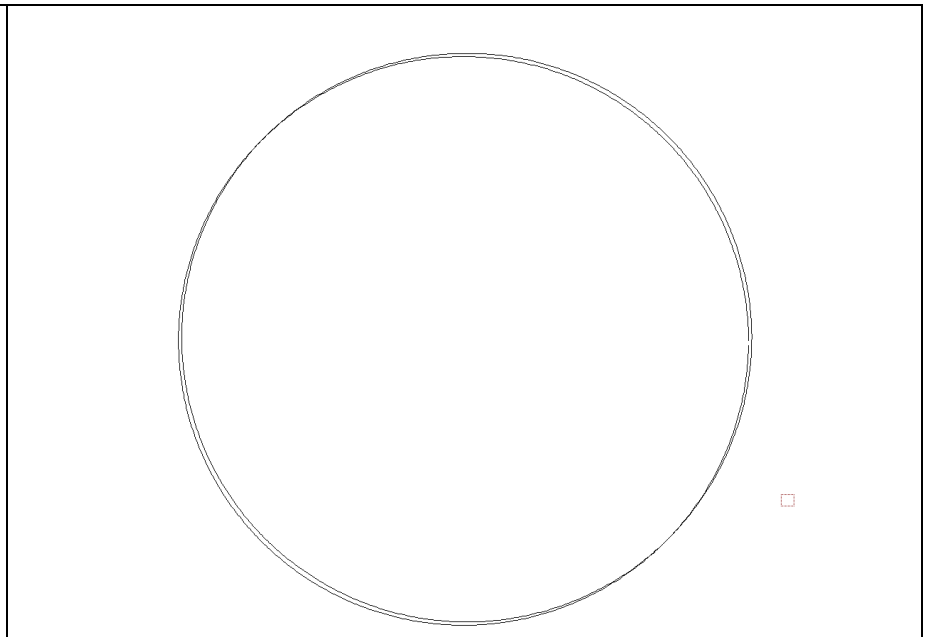
Exposed object		Lethality	OKZ	OO	OE	Collective risk	Perceived collective risk	Individual risk
a1: House	AMRISK 2.0	2.47×10^{-5}	4.95×10^{-5}	1.00×10^{-5}	1.03×10^{-5}	2.76×10^{-10}	2.83×10^{-10}	1.36×10^{-10}
	AMRISK 2.5	2.46×10^{-5}	4.93×10^{-5}	1.00×10^{-5}	1.03×10^{-5}	2.75×10^{-10}	2.82×10^{-10}	1.35×10^{-10}
a2: House	AMRISK 2.0	1.02×10^{-2}	2.04×10^{-2}	1.84×10^{-4}	1.91×10^{-4}	5.05×10^{-9}	5.26×10^{-9}	8.41×10^{-9}
	AMRISK 2.5	9.64×10^{-3}	1.93×10^{-2}	1.74×10^{-4}	1.81×10^{-4}	4.77×10^{-9}	4.97×10^{-9}	7.94×10^{-9}
F1: Area	AMRISK 2.0	2.65×10^{-1}	2.65×10^{-1}	1.40×10^{-1}	1.48×10^{-1}	3.86×10^{-6}	4.08×10^{-6}	7.28×10^{-7}
	AMRISK 2.5	2.65×10^{-1}	2.65×10^{-1}	1.40×10^{-1}	1.48×10^{-1}	3.86×10^{-6}	4.08×10^{-6}	7.28×10^{-7}
v1: Waterway	AMRISK 2.0	1.82×10^{-2}	3.61×10^{-1}	1.92×10^{-1}	2.02×10^{-1}	5.26×10^{-6}	5.56×10^{-6}	
	AMRISK 2.5	1.81×10^{-2}	3.61×10^{-1}	1.92×10^{-1}	2.02×10^{-1}	5.26×10^{-6}	5.56×10^{-6}	
All objects	AMRISK 2.0					9.13×10^{-6}	9.64×10^{-6}	
	AMRISK 2.5					9.13×10^{-6}	9.64×10^{-6}	

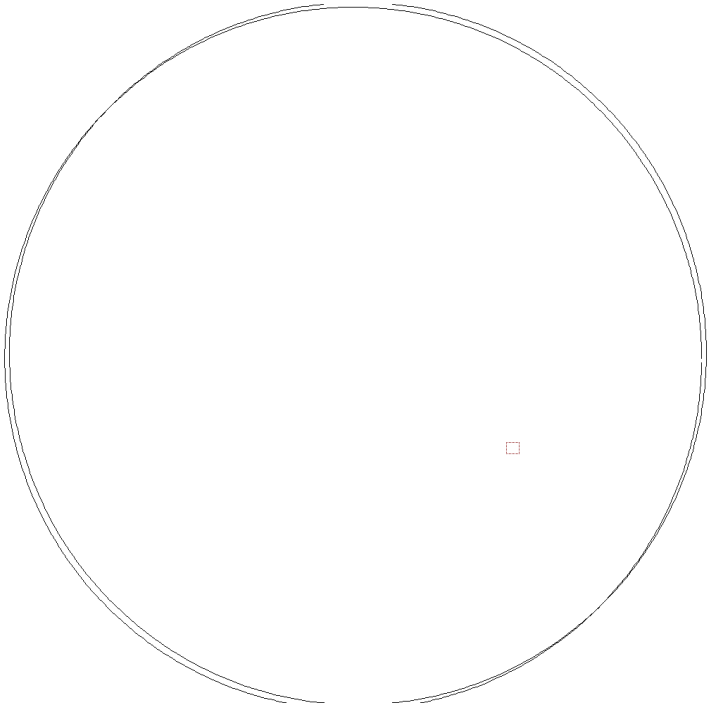
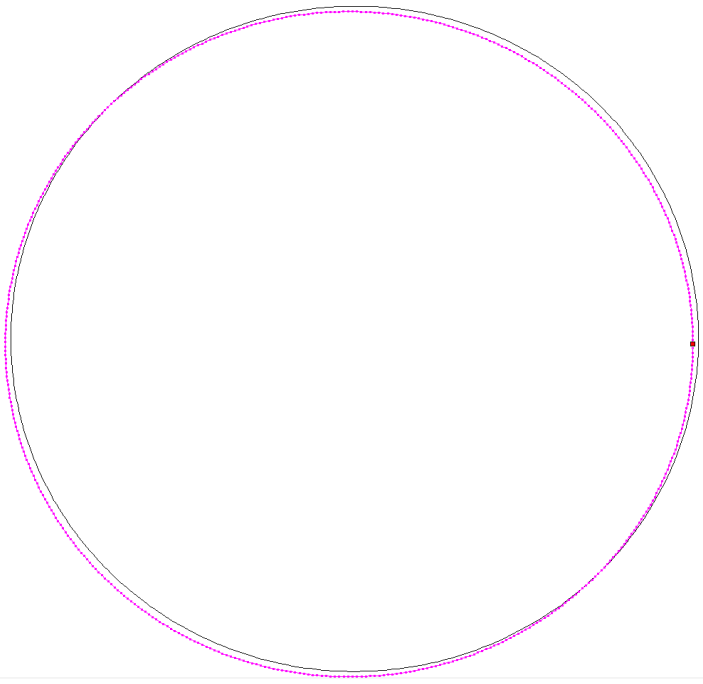
C Isorisk comparisons

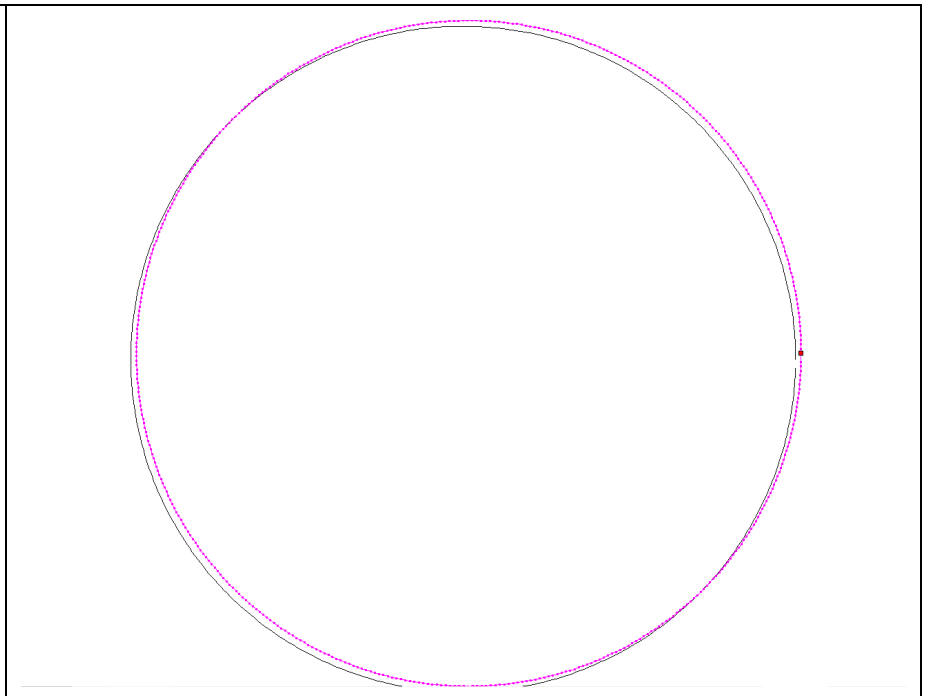
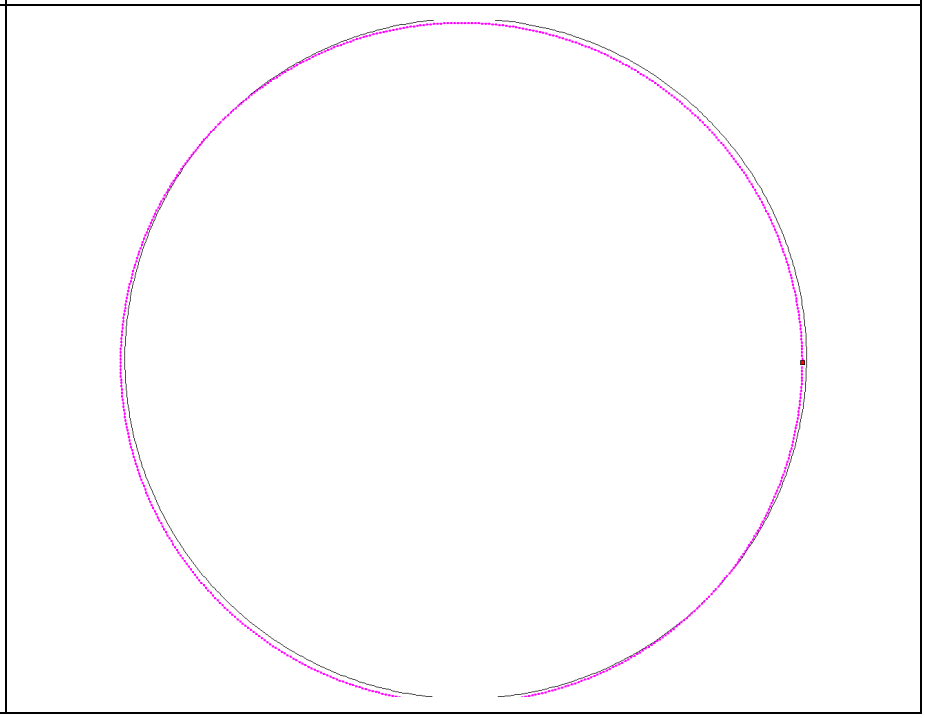
The isorisk contours gives the positions where the individual risk is at the given level.

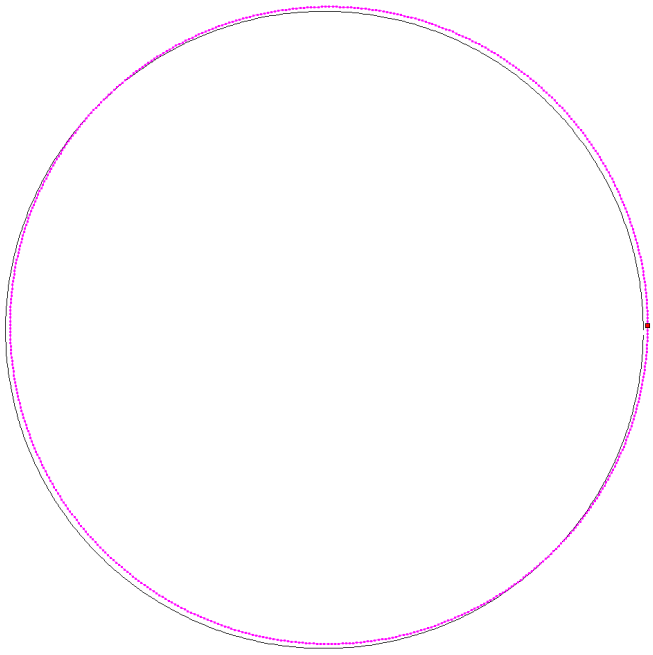
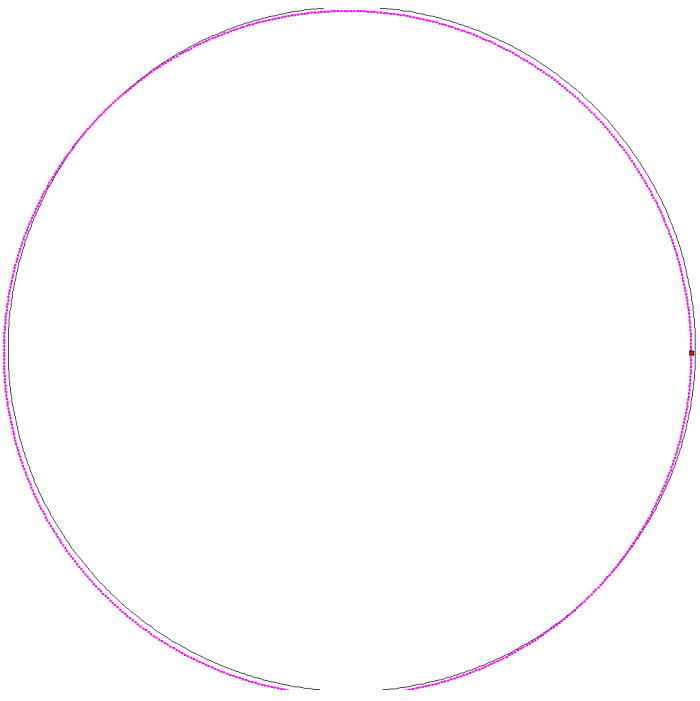
C.1 Reference example 2

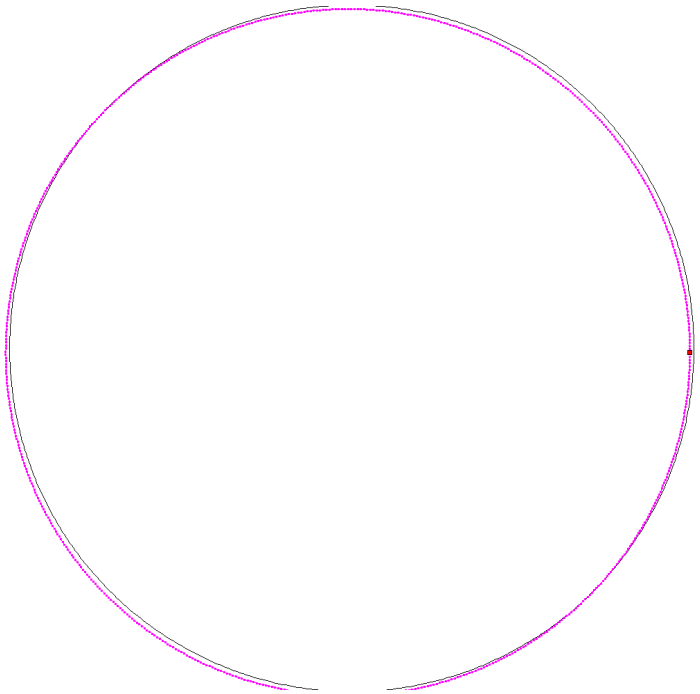
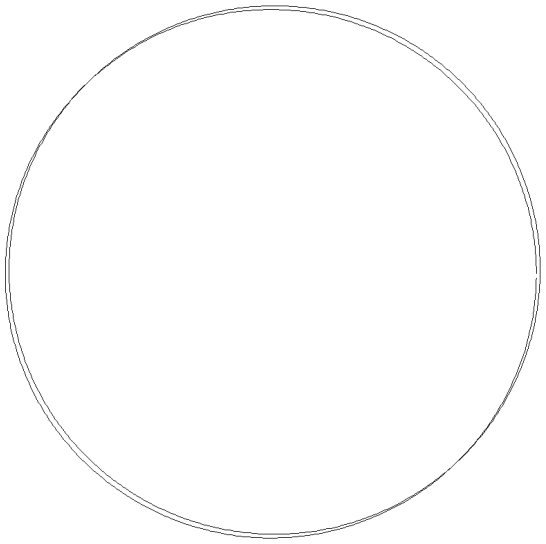
PES: Freestanding magazine

EO: FF/NF Isorisk: 2 x 10^{-7}	

EO: BL/NF Isorisk: 2 x 10^{-7}	
EO: BN/NF Isorisk: 2 x 10^{-7}	

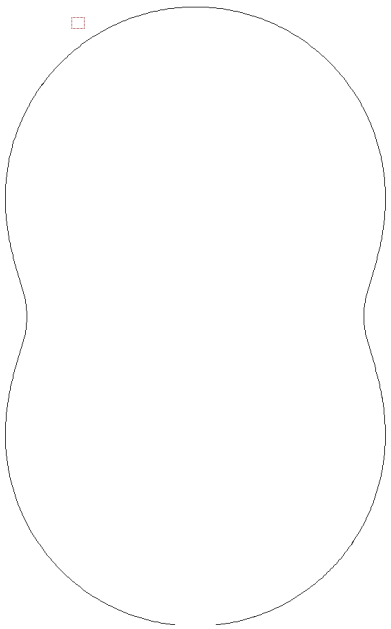
EO: BS/NF Isorisk: 2 x 10^{-7}	
EO: CR/NF Isorisk: 2 x 10^{-7}	

EO: TR/NF Isorisk: $2 \cdot 10^{-7}$	
EO: FF/FO Isorisk: $2 \cdot 10^{-7}$	

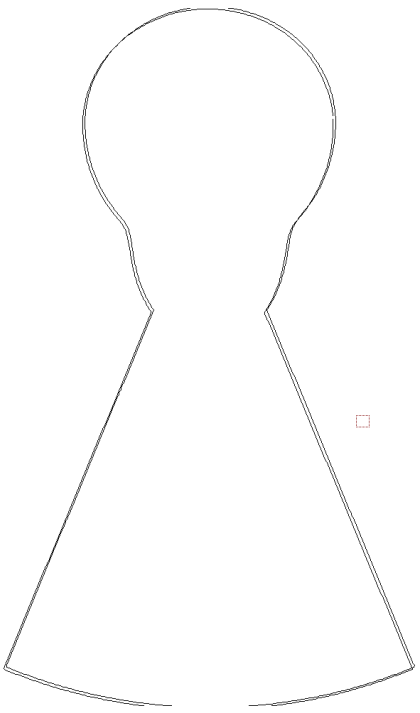
EO: CR/FO Isorisk: $2 \cdot 10^{-7}$	
EO: TR/FO Isorisk: $2 \cdot 10^{-7}$	

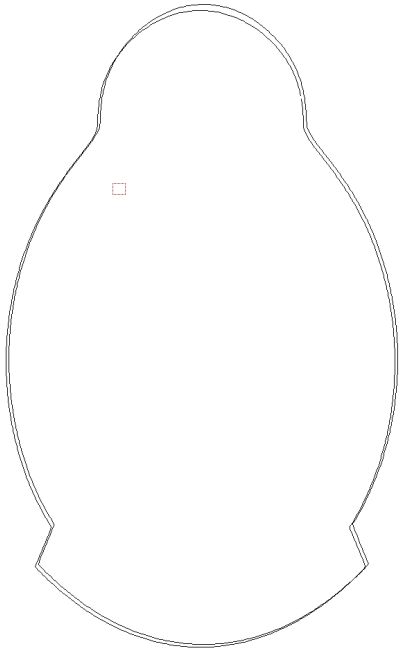
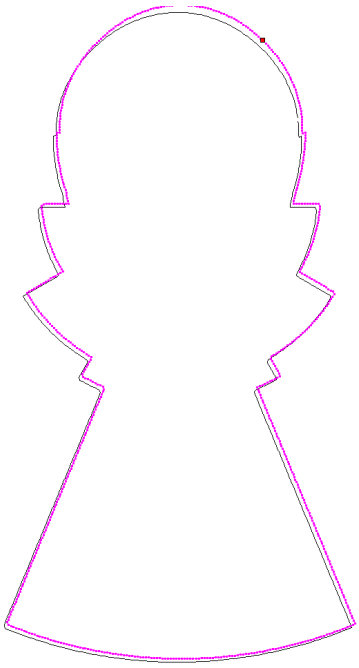
C.2 Reference example 4

PES: Two freestanding magazines

EO: BN/NF Isorisk: 2 x 10^{-7}	

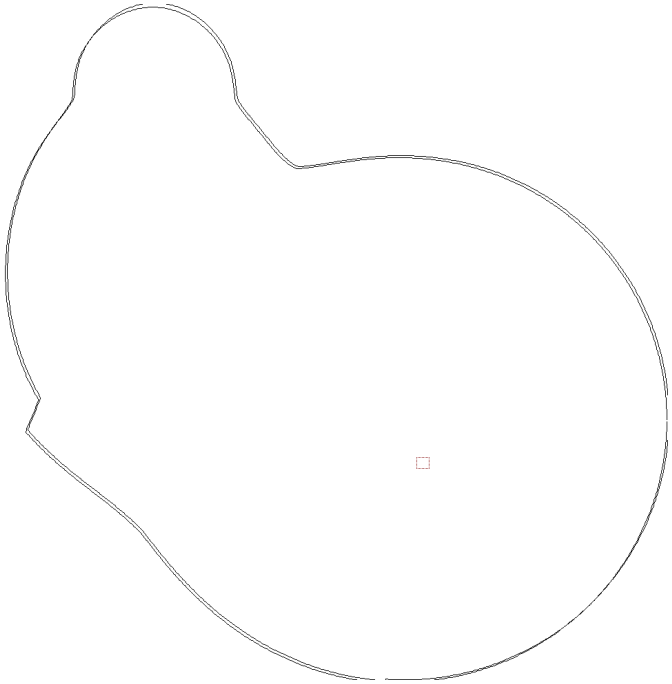
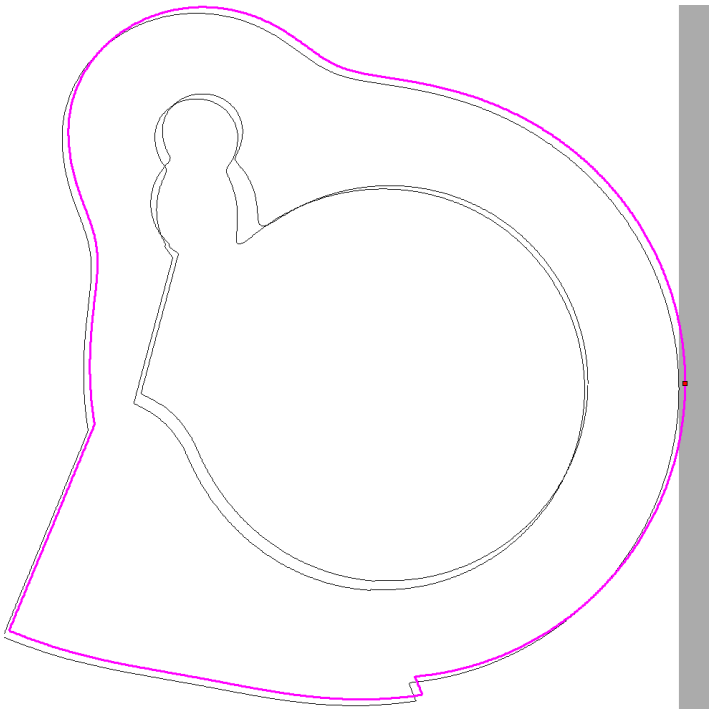
C.3 Reference example 7

PES: UG modified for blast (UG3) EO: TR/NF Isorisk: 2 x 10^{-7}	

PES: UG modified for blast (UG3) EO: BN/NF Isorisk: 2 x 10^{-7}	
PES: UG NO-design (UG2) EO: BN/NF Isorisk: 2 x 10^{-7}	

C.4 Reference example 11

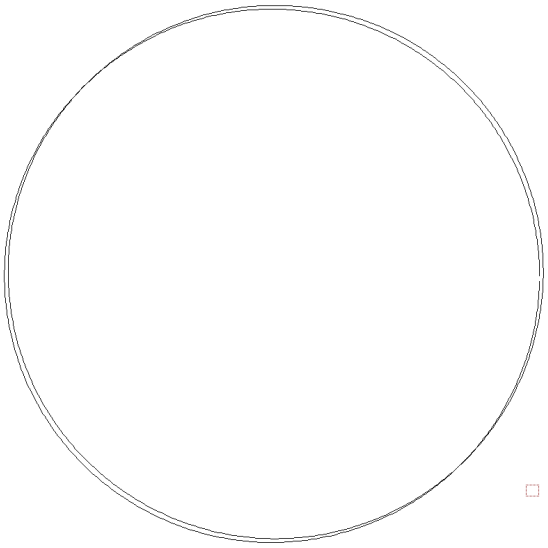
PES: One underground installation and one freestanding magazine

EO: BN/NF Isorisk: 2 x 10^{-7}	
EO: FF/NF Isorisk: 2 x 10^{-6} and 2 x 10^{-8}	

The little deviation in a corner of the 2 x 10^{-6} FF contour is due the incorrect debris density in some sectors in AMRISK 2.0 as described in paragraph 2.2.

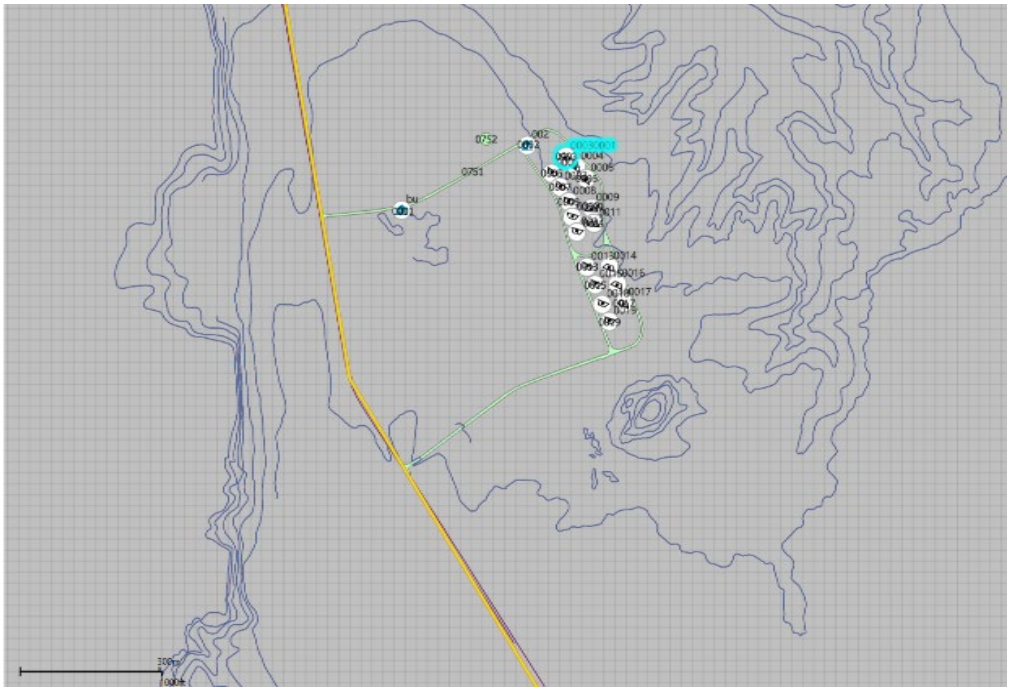
C.5 Reference example 12

PES: Earth-covered magazine

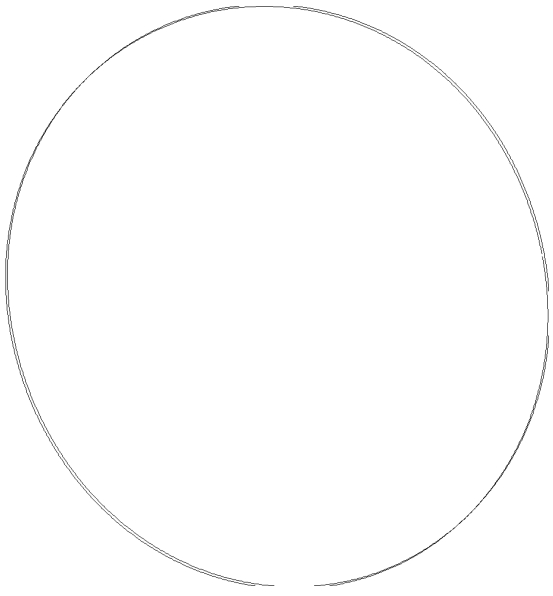
EO: BN/NF Isorisk: 2 x 10^{-7}	

C.6 Example Grøtteskogen

Grøtteskogen is a closed down site with 16 igloo magazines. It is located in a rural area with its main exposure a nearby road as shown below in the screenshot from AMRISK 2.5.



PES: 16 earth-covered magazines
Length 19 m, width 8.3 m, height 4 m
Q = 80 t

EO: BN/NF Isorisk: 2 x 10^{-7}	

D Function tests

Excel file	Functions	Note
Averagelethality_HO_220519	Average lethality along a line with a given start and end point	Calculates the average lethality for 10 m steps along a straight line in the coordinate system
CHMBLA12_3_20	Change of pressure and duration through a straight tunnel element	
EarthBurriedMagazine260619	Pressure, impulse and debris density outside an earth-buried magazine	
EarthCoveredMagazine140219	Pressure, impulse and debris density outside an earth-covered magazine	
FreestandingMagazine130219	Pressure, impulse and debris density outside an earth-covered magazine	
GeometryCalculations 0401dah	Angle between a vector from the magazine entrance to a point and the magazine axis Distance between two points	Angle calculation between the two vectors: • From magazine centre to exposed object • From magazine centre towards front of magazine
Lethality_deb_tuncra_BuildingLight_HO_221019	Lethality in buildings from crater debris distance and in light buildings and trains from tunnel debris distance	
LethalityBuildingLight_YEK_110119	Lethality from pressure and debris density in light buildings	
LethalityBuildingNormal_YEK_210119	Lethality from pressure and debris density in normal buildings	
LethalityBuildingStrong_YEK_210119	Lethality from pressure and debris density in strong buildings	
LethalityCar130219	Lethality from impulse and debris density in cars	
LethalityFireball_HO_100119	Lethality from fireball in free-field	

Excel file	Functions	Note
LethalityFreeField130219	Lethality from pressure, impulse and debris density in free-field	
LethalityTrain130219	Lethality from impulse and debris density in trains	
LethalityUtilFunctions_HO_040119	Standard cumulative normal distribution	
New_BlastInChamber CE	Pressure and duration outside a chamber both with and without a block, ground shock distance from chamber	
New_BlastInTunnel	Change of pressure and duration through different types of tunnel elements (expansion, orifce, constriction, blind tunnel, turn, four types of junctions)	Includes a straight tunnel element, which is also in CHMBLA12_3_20.
New_Diverse_se	Reduction of debris lethality outside tunnels due to barricades Angle between a vector from the tunnel mouth to a point and the tunnel axis Relative distance in tunnel axis	 Different from similar function in GeometryCalculations 0401dah The distance is specific and scaled according to distance, type of tunnel ext, charge, volume and duration.
PressureParameters_RD_140119	Simplified Kingery formula for pressure and duration outside magazines	
ScaleDistance130219	Scaled distance	
Specsific_crater_distance_HO_221119	Pressure and impulse outside UG1 and UG2 tunnels Debris distance, pressure and impulse from crater	
Underground_BuildingNormal_YEK	Lethality in normal buildings from specific distance for tunnel and crater debris	UG3 is not included.
Underground_BuildingStrongYEK	Lethality in strong buildings from specific distance for tunnel and crater debris	Lethality from tunnel debris is the same for normal and strong buildings. Lethality from crater debris is the same for all building types. Also given in Lethality_deb_tuncra_BuildingLight_HO_221019.

Excel file	Functions	Note
Underground_FreeFieldYEK	Lethality in free-field from specific distance for tunnel and crater debris	
Underground_LethalityCarYEK	Lethality in cars from specific distance for tunnel and crater debris	Lethality from tunnel debris is the same for free-field and cars.
Underground_TrainYEK	Lethality in cars from specific distance for tunnel and crater debris	Lethality from tunnel debris is the same for trains and light buildings, see Lethality_deb_tuncra_BuildingLight_HO_221019. Lethality from crater debris is the same for cars and trains.
PorobilEvent_HO_200820	Probability of event for different magazine types	

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FFI turns knowledge and ideas into an efficient defence.

FFI's characteristics

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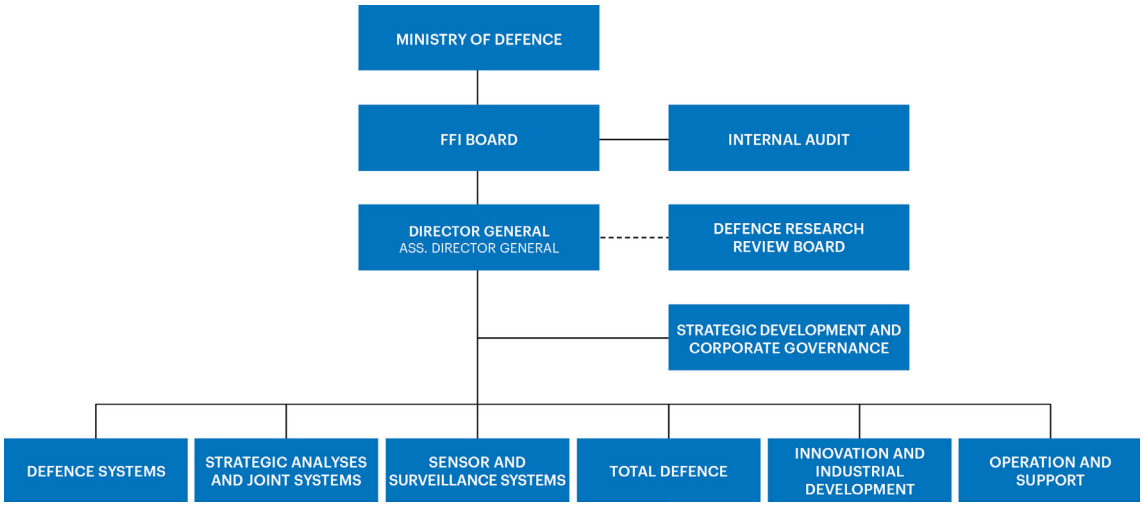

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