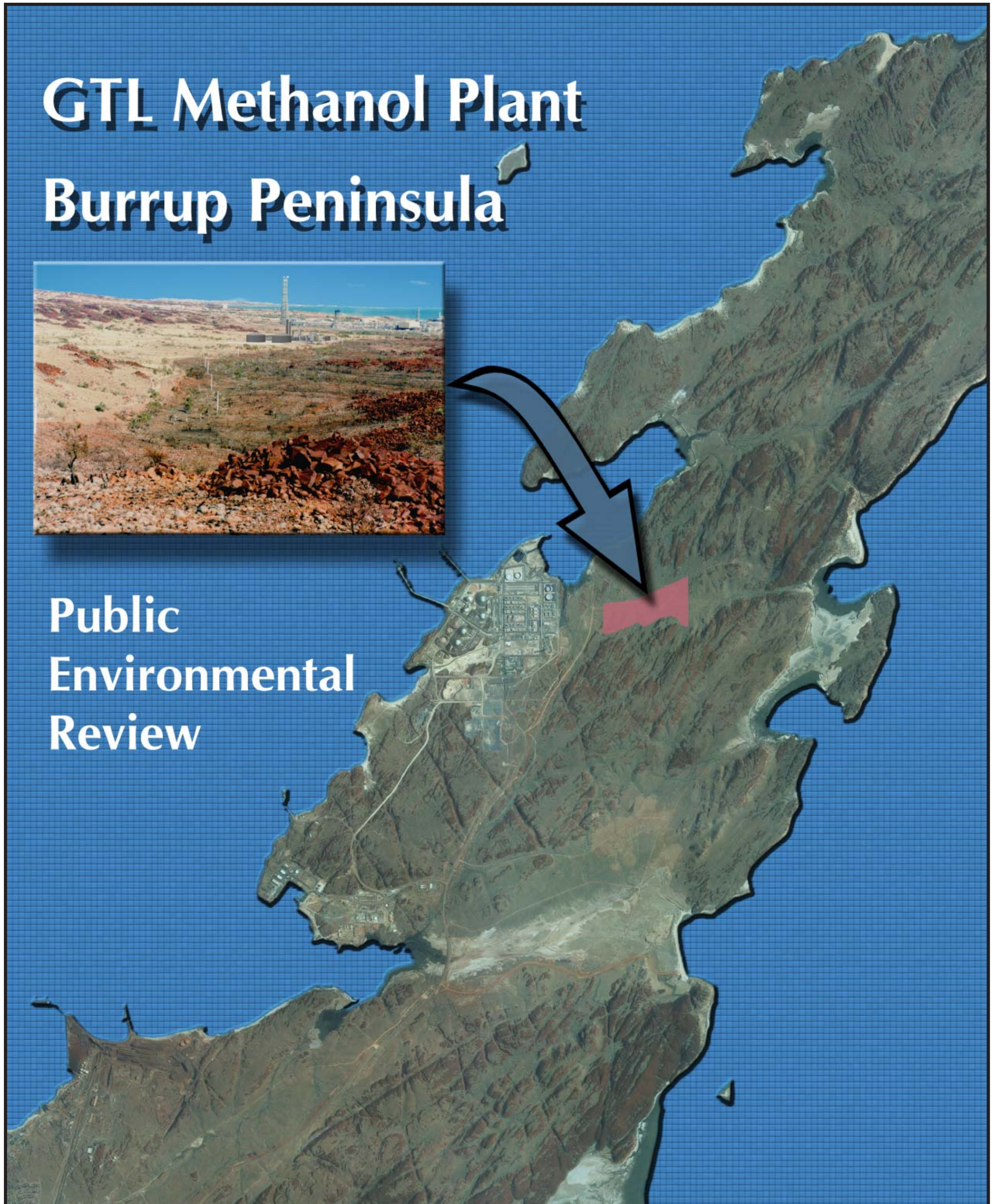
# GTL Methanol Plant

# Burrup Peninsula



## Public Environmental Review

**Volume 3 - Appendix M**

URS

GTL RESOURCES PLC.

## INVITATION TO MAKE A SUBMISSION

The Environmental Protection Authority (EPA) invites people to make a submission on this proposal. If you are able to, electronic submissions emailed to the DEP/EPA Project Assessment Officer would be most welcome.

GTL Resources PLC proposes to construct a methanol plant on the Burrup Peninsula, Western Australia. In accordance with the *Environmental Protection Act 1986*, a Public Environmental Review (PER) has been prepared which describes this proposal and its likely effects on the environment. The PER is available for a public review period of 4 (four) weeks from 9 September 2002, closing on 7 October 2002. Comments from government agencies and from the public will help the EPA to prepare an assessment report in which it will make recommendations to government.

**Why write a submission?**
A submission is a way to provide information, express your opinion and put forward your suggested course of action – including any alternative approach. It is useful if you indicate any suggestions you have to improve the proposal.

All submissions received by the EPA will be acknowledged. Submissions will be treated as public documents unless provided and received in confidence subject to the requirements of the Freedom of Information Act, and may be quoted in full or in part in the EPA's report.

**Why not join a group?**
If you prefer not to write your own comments, it may be worthwhile joining with a group interested in making a submission on similar issues. Joint submissions may help to reduce the workload for an individual or group, as well as increase the pool of ideas and information. If you form a small group (up to 10 people), please indicate all the names of the participants. If your group is larger, please indicate how many people your submission represents.

**Developing a submission**
You may agree or disagree with, or comment on, the general issues discussed in the PER or the specific proposals. It helps if you give reasons for your conclusions, supported by relevant data. You may make an important contribution by suggesting ways to make the proposal more environmentally acceptable.

When making comments on specific elements of the PER:
- clearly state your point of view;
- indicate the source of your information or argument if this is applicable; and
- suggest recommendations, safeguards or alternatives.

**Electronic submissions**
It is requested that a single consolidated email response be provided after you have reviewed the full PER. Please note that, where an email response is received, an additional hard copy is not required (except for attachments that cannot be forwarded electronically). You will receive an electronic acknowledgement of your submission and will also be advised electronically when the EPA's report and recommendation become available.

**Points to keep in mind**
By keeping the following points in mind, you will make it easier for your submission to be analysed:
- attempt to list points so that issues raised are clear. A summary of your submission is helpful;
- refer each point to the appropriate section, chapter or recommendation in the PER;
- if you discuss different sections of the PER, keep them distinct and separate, so there is no confusion as to which section you are considering; and
- attach any factual information you may wish to provide and give details of the source. Make sure your information is accurate.

Remember to include:
- your name;
- address;
- date; and
- whether you want your submission to be confidential.

The closing date for submissions is: 7 October 2002

Submissions should ideally be emailed to: ann.barter@environ.wa.gov.au

OR addressed to:
The Environmental Protection Authority
Post Office Box K822
PERTH WA 6842
Attention: Ms Ann Barter

# Appendix M

*Preliminary Risk Assessment*
*by QEST Consulting Group*

Department of
**Mineral and Petroleum Resources**

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**Attention: Ms Ann Barter**

**METHANOL PLANT AND PRODUCT EXPORT (ASSESSMENT NO. 1438)**
**GTL RESOURCES PLC**
**PRELIMINARY RISK ASSESSMENT - REV 1**

I refer to the revised Preliminary Risk Assessment (PRA) submitted by Qest Consulting Group for the proposed GTL Resources Methanol Plant.

I have reviewed the document and am of the opinion that the PRA is a reasonable representation of the risk levels from the proposed methanol plant, given that the PRA was conducted based on preliminary drawings with limited information relating to the facility.

An outcome of the PRA is that the fifty-in-a-million contour does not extend beyond the site boundary. However, the Environmental Protection Authority (EPA) individual risk criterion for 'non-industrial activity' or 'active open spaces', may be exceeded depending on the classification of land-use around the site, as the ten-in-a-million contour extends beyond the site boundary by approximately 110m to the north and 60m to the south.

It is noted that the land to the north of the site is classified as an industrial area. As the ten-in-a-million contour extends into this area, it is recommended that the affected area be restricted to industrial use only.

As to the land within the ten-in-a-million contour to the south of the site, it is recommended that measures be implemented to ensure that this land is not used in a manner contrary to the expected level of risk from the plant. This is particularly important, as I understand that there are rock engraving sites and related artefacts in the vicinity of the ten-in-a-million contour.

As the PRA was conducted based on preliminary information, a Quantitative Risk Assessment (QRA) based on the final design, is required prior to commissioning of the plant, as per the recommendation made in the PRA. The QRA should verify the assumptions made in the PRA and in particular it should address the following items:

1. The potential for all knock-on/escalation effects associated with the operation of plant as well as the pipeline and loading facility, should be considered in sufficient detail. For the pipeline and loading facility, the potential impact to and from any other dangerous goods pipelines and stores in the vicinity needs to be included.

2. Calculation of consequences and assessment of risk from all hazardous events associated with the loading operations to determine whether an exclusion zone is required.

3. Calculation of risk based on the actual inventory likely to be released in a hazardous event taking into consideration the capability and limitations of the emergency shutdown system, such as time required to achieve an isolation.

4. The possibility of catastrophic failures and full-bore releases of all equipment should be considered.

5. Verification that a 60-second response time for manual shutdown is achievable.

6. A list of credible scenarios and a description of each event should be included.

Please do not hesitate to contact me if you have any queries regarding the above.

Jeff Kong
Major Hazards Inspector
SAFETY, HEALTH AND ENVIRONMENT DIVISION

1 August 2002

::ODMA\DME-MSE\DME-296293

cc: URS – Ian Baxter
Qest Consulting Group – Melissa Monaghan
MPR, Office of Major Projects – Ben Peden

# PRA FOR A METHANOL MANUFACTURING PLANT

## GTL RESOURCES LTD

*Prepared by: Qest Consulting Group*

*Rev 1, May 2002*


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***Risk, Safety and Health Consultants***

PRA for a Methanol Manufacturing Plant for GTL Resources Ltd

**Acknowledgment**

Qest Consulting Engineers compiled this report, but it is a joint effort between QEST team members and GTL Resources personnel. The author of this report wishes to thank the participants for their diligence during the assessment, and for their efforts in providing the information required to prepare this report.

**Disclaimer**



| Document Revision Record | | | | | |
|---|---|---|---|---|---|
| **Title:** | PRA for a Methanol Manufacturing Plant | | | | |
| **Job No:** | URS5p | | | | |
| **Revision:** | **Description:** | **Prepared by:** | **Checked by:** | **Approved by:** | **Date:** |
| A | Draft for comment | M.Monaghan / J.Muirhead / M.Sheehy | R.Keys / S.Lee Scanlin | | 7/01/02 |
| 0 | Final Issue | J.Muirhead | M.Monaghan | R. Keys | 21/1/02 |
| 1 | Revised Final Issue incorp MPR / DEP comments | J.Muirhead | M.Monaghan | M.Monaghan | 10/5/02 |
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# GLOSSARY

| | |
|---|---|
| ALARP | As Low As Reasonably Practicable |
| APC | Advanced Process Control |
| ASU | Air Separation Unit |
| BAT | Best Available Technique |
| BFW | Boiler Feed Water |
| BLEVE | Boiling Liquid Expanding Vapour Explosion |
| DBNGP | Dampier to Bunbury Natural Gas Pipeline |
| DCS | Distributed Control System |
| DEP | Department of Environmental Protection |
| DOLA | Department of Land Administration |
| DPA | Dampier Port Authority |
| EPA | Environmental Protection Authority |
| ESD | Emergency Shutdown System |
| FEA | Fire and Explosion Analysis |
| GTL | GTL Resources |
| HAZOP | Hazard and Operability Study |
| HP | High Pressure |
| HTS | High Temperature Shift Converter |
| IDLH | Immediately Dangerous to Life and Health |
| IMO | International Marine Organisation |
| IRPA | Individual Risk Per Annum |
| LNG | Liquid Natural Gas |
| LP | Low Pressure |
| LPG | Liquid Petroleum Gas |
| LTS | Low Temperature Shift Converter |
| MP | Medium Pressure |
| MPS | Machine Protection System |
| OD | Outside Diameter |
| OTS | Operator Training Simulator |
| PFD | Process Flow Diagram |
| PLC | Programmable Logic Controller |
| PRA | Preliminary Risk Assessment |
| PSA | Pressure Swing Adsorption Unit |
| QA | Quality Assurance |
| SCW | Sweet Cooling Water System |
| SIL | Safety Integrity Level |
| SIS | Safety Instrument System |
| STP | Standard Temperature and Pressure |
| TLV | Threshold Limit Value |
| TMR | Triple Modular Redundant System |
| URS | URS Australia Pty Ltd |
| WA-DMPR | Western Australian Department of Minerals and Petroleum Resources |

# 1 EXECUTIVE SUMMARY

GTL Resources (GTL) have requested QEST Consulting Engineers to prepare a Preliminary Risk Assessment (PRA) for the proposed GTL Methanol Manufacturing Plant located in the Withnell East area of the Burrup Peninsula.

The objective of the PRA is to demonstrate that as far as reasonably practicable:

- offsite risks have been minimised, firstly through elimination of hazards and secondly through control of remaining hazards; and
- the level of risk to persons located offsite as measured by defined criteria is within tolerable limits.

The scope of the PRA comprises the following:

- Hazard identification;
- Hazard and risk assessment; and
- Evaluation and selection of hazard and risk control measures.

The hazards under consideration in this study are those associated with the operations at the GTL Methanol Manufacturing Plant that have the potential to extend beyond the boundaries of the plant area.

## 1.1 Results

### 1.1.1 Risk Criteria

The IRPA criteria as stated in EPA Guidance Note No. 2 [6] are:

a A risk level in residential zones of one in a million per year (1E-6) or less, is so small as to be acceptable to the EPA.

b A risk level in "sensitive developments", such as hospitals, schools, child care facilities and aged care housing developments of between one half and one in a million per year (0.5E-6 to 1E-6) is so small as to be acceptable to the EPA. In the case of risk generators within the grounds of “sensitive development” necessary for the amenity of the residents, the risk level can exceed the risk level of one half in a million per year (0.5E-6) to a maximum of one in a million per year (1E-6) for areas that are intermittently occupies, such as garden areas and car parks.

c Risk levels from industrial sites should not exceed a target of fifty in a million per year (50E-6) at the site boundary for each individual industry, and the cumulative risk level imposed on an industry should not exceed a target of one hundred in a million per year (100E-6).

d A risk level for any non-industrial activity or active open spaces located in buffer areas between industrial facilities and residential zones of ten in a million per year (10E-6) or lower, is so small as to be acceptable to the EPA.

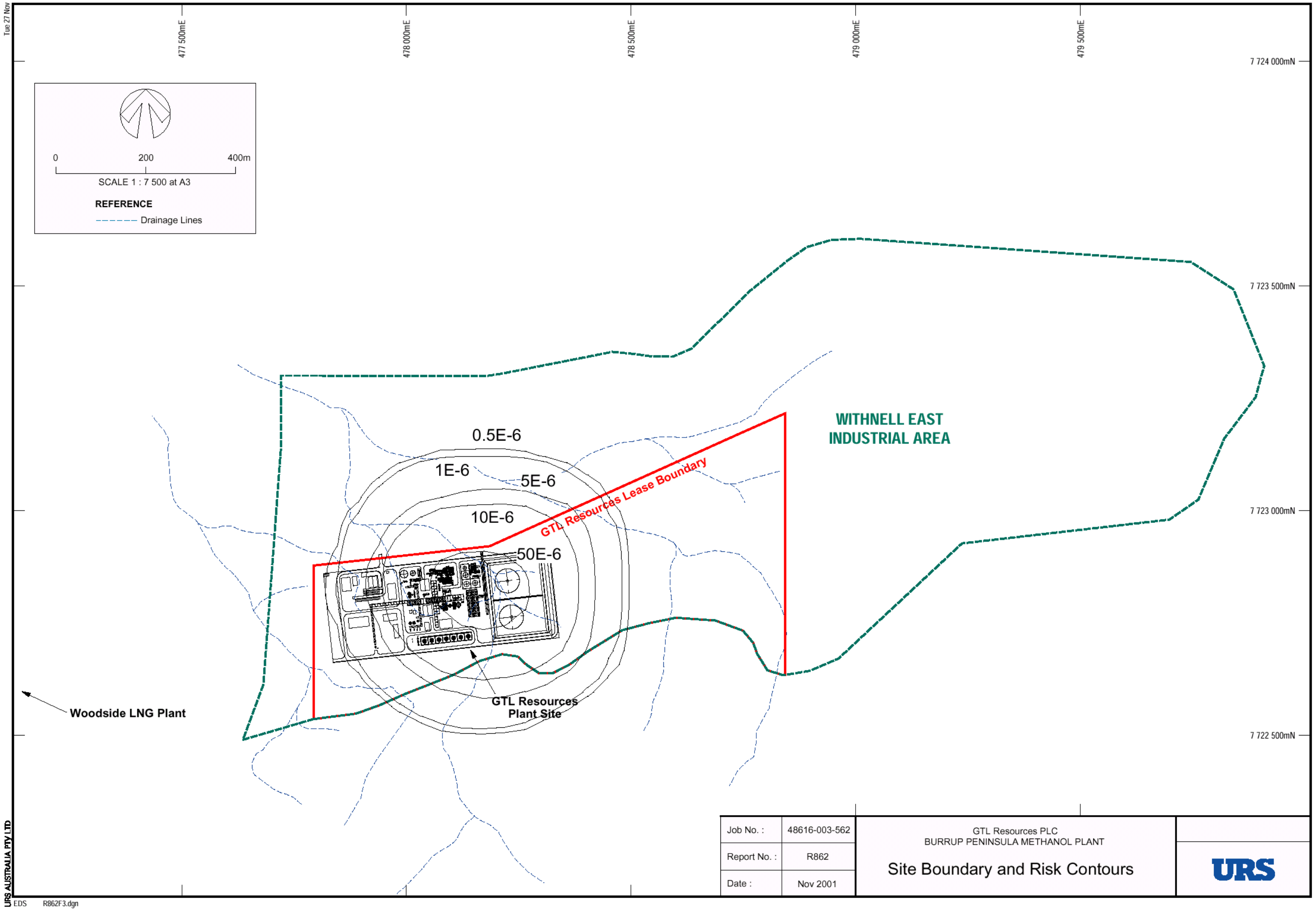
e A risk level for commercial developments, restaurants and entertainment centres, located in buffer areas between industrial facilities and residential areas, of five in a million per year (5E-6) or less, is so small as to be acceptable to the EPA.

### 1.1.2 Individual Risks

The 50E-6 risk contour from the GTL Methanol Plant does not extend beyond the site boundary. The 10E-6 contour extends no more than 200m from the north and south of the site boundary. The area north of the site boundary is within the Withnell East Industrial Estate and thus the risk above 10E-6 is acceptable. There is a road which the 10E-6 contour washes over, but this is designated and marked as a private road for access to the Woodside communications tower, thus the risk above 10E-6 is acceptable due to the infrequent use of the road. The area to the south of the plant is conservation land with elements that are significant to aboriginal heritage. However, there are no areas designated as “significant” heritage location within the 10E-6 contour. The infrequent use of the land means this level of risk is acceptable. Therefore the plant is considered to comply with the EPA Criteria [6] for individual risk.

The various risk contours considered for the GTL Methanol Plant are presented in Figure 1-1. A version of the contours with geographical detail is available in Appendix M.

***Figure 1-1 Methanol Plant Risk Contours***



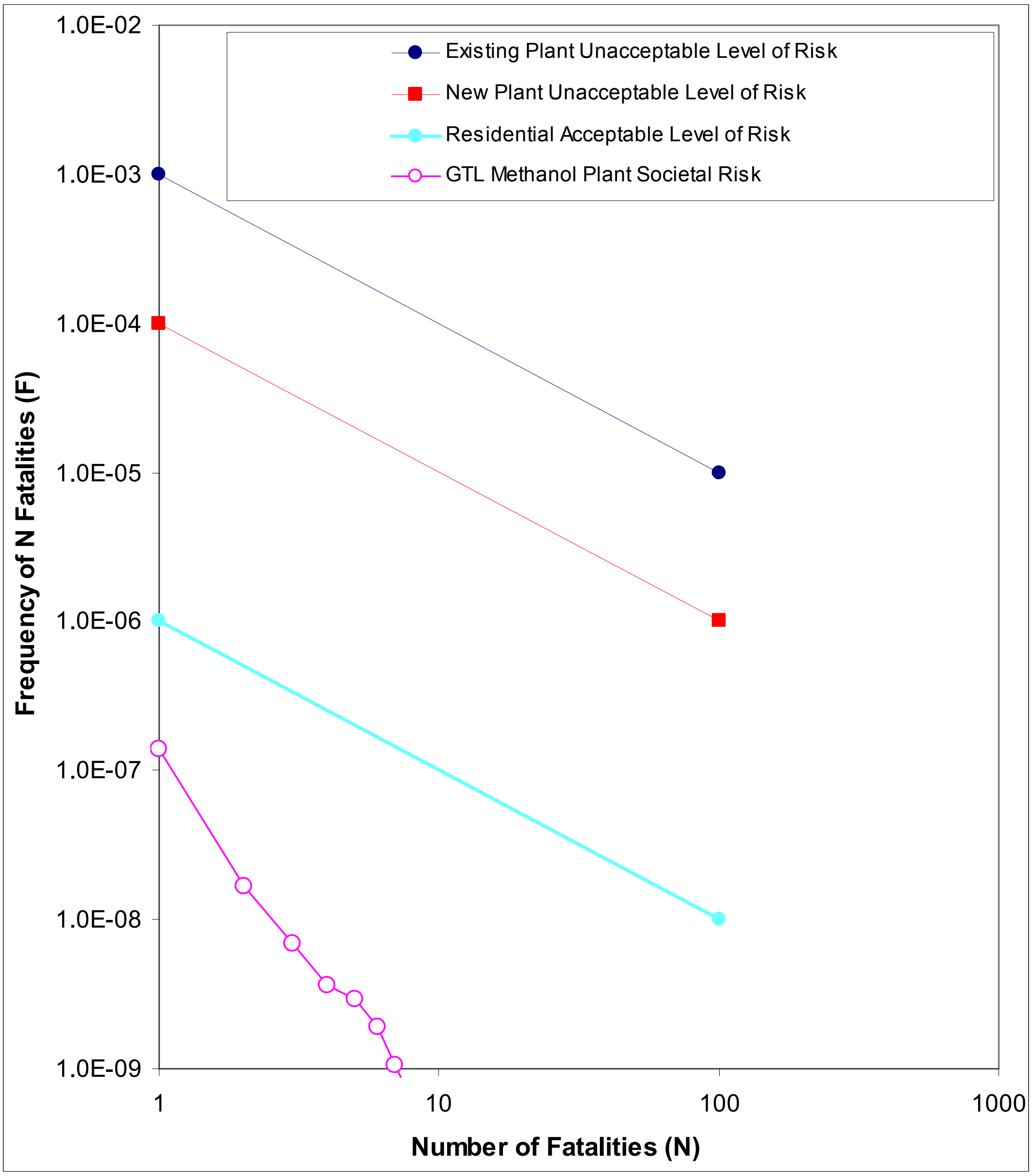
### 1.1.3 Societal Risks

The Societal Risks from the GTL Methanol Plant are given in Figure 1-2.

For the GTL Methanol Plant analysis, the criterion used to assess societal risk are demonstrated by the legend in Figure 1-2. This is the societal risk model developed for the Kwinana (W.A.) industrial area which is accepted by the W.A. regulatory authorities as no formal W.A. criteria exists.

In the figure, the three lines represent limits of acceptable risk. As seen in Figure 1-2, the societal risk from this plant satisfies the societal risk criteria as the F-N curve lies beneath the limit of unacceptable risk for new plants.

***Figure 1-2 : GTL Methanol Manufacturing Plant Societal Risk Contours***



### 1.1.4 Impacts from internal events

A brief summary of the major risk contributors and their potential knock-on effects are provided in the following table.

***Table 1.1 : Risk Contributions Including Internal Knock-on Effects***

| Internal Event | Comment |
|---|---|
| Natural gas feed line release | Releases due to pipeline failure because of material of construction or maintenance faults or external impacts. The ignited jet flame extends for approximately 212m for a full pipe rupture. Unit 200 Methanol Synthesis is within this 212m radius. The impingement on the Methanol Synthesis unit may result in fires and/or explosions in this unit. |
| Methanol Plant – Flammable (methane, hydrogen or methonal) release | Risks from knock-on effects from fires and explosions are minimal, as the frequency for these events is relatively low. The knock on release would have minimal impact as the process would be isolated and blown down / vented away from the process area before vessels would fail. |
| Methanol Storage | The risk is minimal as the large scale poolfires which could result from the methanol storage tanks would require a substantial external impact to initiate. |
| Export Pump | The likelihood of an event impacting beyond the boundary is very low due to the number of protection devices that would ensure any release was of short duration. |
| Pipeline from Plant to the Wharf | Risk is very low due to the low frequency at which fully welded pipelines leak. |
| Marine Loading Arm | Risk is very low due to the low frequency of the event (and minor consequences) due to the many protection devices that would have to fail for an ongoing release. Protection includes:<br>• ESD system automatically activated on no-flow signal.<br>• All other activity on the wharf cease throughout tanker loading operations.<br>• An operator stationed at the wharf throughout the entire loading operation. |
| Shipping Hazards Collision, Grounding, and Onboard Incident | Risk very low due to the very low frequency of the event. |

### 1.1.5 Impacts from external events

The possible impact and knock on effects from other existing or potentially hazardous operations in the surrounding area are given in the following Table 1-2.

***Table 1-2 : External Knock-on Effects***

| External Event | Comment |
|---|---|
| LNG Plant and export jetties | The $1x10^{-6}$ contour for the Woodside LNG plant does not impinge on the GTL Methanol plant, thus a knock-on effect from these facilities is very unlikely. |
| Plenty River Ammonia Urea Plant | This plant is located approximately 3.3 km to the SSE and hence will be unaffected by any incidents. |
| Burrup Fertilisers Site | This plant is located approximately 3 km to the SSE and hence will be unaffected by any incidents. |

### 1.1.6 Risk Reduction Measures

The risk reduction measures considered for this facility are in Table 1-3.

***Table 1-3 : Proposed Risk Reduction Measures***

| | Risk Reduction Measures |
|---|---|
| 1. | Develop a Safety Management Plan |
| 2. | Put in place an Emergency Response Plan that provides a rapid response to identified releases that would facilitate early manual isolation of any leaking equipment |
| 3. | Develop a Joint Industrial Integrated Emergency Management Plan with Woodside. |
| 4. | Ensure fire fighting measures such as deluge systems are addressed and incorporated in the final design. |
| 5. | Ensure the gas detection systems in the final design include sensors for the fuel gas and $CO_2$ in areas that are both enclosed and open to increase likelihood of the detection of leaks. |
| 6. | Ensure the final design of the offloading systems incorporate shutdown systems that can be controlled by the operator at the loading point. |
| 7. | Designate an exclusion zone during loading of the export tankers at the wharf. This will be assessed when the final wharf and offloading system are designed. |

# 2 INTRODUCTION

## 2.1 Background to this Study

GTL Resources Limited (GTL), the proponent for this project, proposes to construct an export oriented Methanol complex in the Pilbara region of Western Australia. The proposed plant will convert natural gas into Methanol at a design capacity of 3,000 tonnes per day (tpd). A site has been selected for the complex at the Withnell East area on the Burrup Peninsula.

The Western Australian Department of Environmental Protection (DEP) has advised GTL that further consideration of the selected site for the proposed project would be subject to the preparation and government review of a Preliminary Risk Assessment (PRA) document. URS have been commissioned by GTL to provide the necessary technical information to enable the PRA to be prepared based on proprietary methanol manufacturing technology.

QEST Consulting Engineers Pty Ltd have been commissioned by URS as independent risk assessment consultants to carry out a Preliminary Risk Analysis for the project.

## 2.2 Study Aims and Objectives

The aim of this study is to:

- Review the proposal, identify potential hazards and assess the risks associated with these hazards; and
- Demonstrate that the proposal meets the DEP requirements as outlined in EPA Guidance No.2: Guidance for Risk Assessment and Management: Offsite individual risk from Hazardous Industrial Plant [6].

## 2.3 Scope of Work

The work involves the undertaking of a preliminary risk analysis for the proposed Methanol plant and will discuss and recommend measures that may be used to minimise risks.

The Study addresses all aspects nominated in the EPA guidelines (refer Appendix D) and specifically included assessments of the following risks:

- Leakage or failure of process equipment;
- Hazards of supply, process, storage operations proposed;
- Knock-on effects, process fires and explosions, and external events (cumulative risks);
- Methanol export loading; and
- Shipping.

The method by which the proposed plant hazards has been assessed is:

***a Hazard Identification***
Identification of credible hazardous events for the facilities. This is done using the analysts' experience, the design engineers engineering knowledge, experience and a systematic review of the proposed plant.

***b Consequence Analysis***
Analysis of hazardous events identified to define causes and consequences. The following analyses were performed:
- Fire Analysis;
- Toxic Release Analysis; and
- Pipeline and Transportation Hazards Analysis.

***c Frequency Analysis***
Determination of the frequency at which the hazardous events may occur.

***d Quantitative Risk Analysis***
Quantification of the risk arising from all hazardous events by cumulatively combining the product of frequency and consequence for each event.

***e Assessment of the total project risks by comparing them to the EPA guidelines [5].***

The methodology is described in Section 5 and includes a summary of the inputs and outputs provided. All assumptions have been listed. Results are presented in the form of risk contours. The results are then compared to the EPA criteria and conclusions drawn.

## 2.4 Nature of the Project

The proposal is to establish an export oriented Methanol complex that meets the captive needs of the international market. The plant would be of modern and proven design incorporating contemporary safety standards.

The proposed plant capacity is 3000mtpd of Methanol, stored in two atmospheric Methanol storage tanks.

The proposed site for the Methanol plant is in the Withnell East Area.

## 2.5 Philosophy of Approach to Risk Assessment

The potential for major incident events arising in plants that process, store or transport hazardous materials warrant special measures to ensure the safety of the public, the workforce and the environment.

One of the best approaches, designed to assist in maintaining the safety of the public and the workforce when developing such facilities, is Risk Assessment. This approach requires the use of a range of analytical techniques and calculation methods to identify and evaluate the hazards and risks associated with a process or facility.

The primary purpose is to ensure that all significant risks are identified and properly evaluated to enable appropriate action to be taken to eliminate or reduce the potential for major incident events. The techniques used enable the risk to be quantified in terms of consequence of the hazardous events and frequency of occurrence of these events. These risks can then be reported in terms of the total frequencies (risk levels) of exceeding designated hazard impact levels such as human fatality.

The risks as assessed, can then be compared with the risks associated with other processes and to community standards. Consequently, risk assessment can be used to assist in the approval process for new plant proposals. The risks associated with a new plant are measured against nominated criteria to assist in determining the acceptability of the risk for the proposal involved.

The Preliminary Risk Assessment is conducted using preliminary drawings with limited access to information about the facility. Therefore a more thorough Quantitative Risk Analysis shall be completed prior to the commencement of construction and production operations.

It is essential that competent analysts who achieve an understanding of the processes and risks involved carry out the risk assessment in an objective manner. The risk assessment must be completed in a clear auditable manner with all assumptions detailed.

# 3 PROJECT DESCRIPTION

## 3.1 Site Location and Environment of the Project Site

### 3.1.1 Background - Site Selection

The proposed site for the Methanol plant is located on the Burrup Peninsula which is in the northwest Pilbara region of Western Australia, approximately 1,300 kilometres north of Perth. The Burrup Peninsula extends approximately 20 kilometres north of the coast into the Dampier Archipelago and is surrounded by the shallow waters of Nickol Bay to the east and Mermaid Sound to the west.

The selected site is about 50 hectares in area and is located east of Withnell Bay and east of Woodside's LNG Plant. This site is within the Withnell East Industrial area. The site is approximately 14 and 10 kilometres from the towns of Karratha and Dampier respectively.

Natural Gas feed is taken from a line directly from the Woodside Onshore Treatment Plant (LNG), entering the plant's western lease boundary. GTL Resources' title will be an easement under the Petroleum Pipelines Act from the State (through DOLA) acting with the consent of the Shire of Roebourne and of the Commissioner of Main Roads (within the Burrup Road). Native title has been extinguished on road reserves and therefore the gas supply pipeline raises no native title issues.

An easement will be sought for the Methanol export pipeline to the new purpose-built Dampier wharf.

#### 3.1.1.1 Compatible industrial zoning and adjacent industries

Two proposed ammonia plants (Plenty River & Burrup Fertilisers) are located to the south-east and the proposed Syntroleum synthetic fuels plant is located to the south. The LNG facility (Woodside) is located approximately 1 kilometre to the west.

The Dampier to Bunbury Natural Gas Pipeline (DBNGP) traverses the Burrup Peninsula and is located approximately 1.5 to 2 kilometres south-west of the proposed site.

#### 3.1.1.2 Proximity to existing available port facilities

The Dampier Public Wharf is located about 4.5 kilometres to the south-west of the proposed site and is one of the largest ports in Australia based on tonnage of cargo. The project will have access to the ship-loading facilities at the new purpose-built loading wharf (approximately 300m south of the existing Dampier Public Wharf).

#### 3.1.1.3 Existing trafficable roads

The Burrup Peninsula is serviced by the main north-south aligned Burrup Road. Bordering the site to the west is Withnell Bay Road, which is unsealed.

#### 3.1.1.4 Utility services

Services such as power and water are available primarily through synergies with other proposed projects. The Proponent is designing the plant to be self-sufficient in terms of power.

#### 3.1.1.5 Proximity to the townships of Karratha and Dampier

The proposed site is located about 10 and 14 kilometres from Dampier and Karratha respectively. This distance will ensure minimal impact of the plant on local communities while providing a practical commuting distance for employees.

### 3.1.2 Burrup Peninsula Facilities

#### 3.1.2.1 Location

The plant will be constructed in the Withnell East Area with the potential to maintain considerable separation distances from residential areas. Figure 3-1 shows the Location Map and Figure 3-2 shows the site layout for the proposed Methanol Plant. The Plenty River and Burrup Fertiliser Ammonia Plants marked on Figure 3-1 are proposed developments and are not currently populated.

Nearby populated areas, according to [20,21] are:

| Area | Population | Location |
|---|---|---|
| Woodside Onshore Treatment Plant (LNG) | 100 | 1 km W |
| Plenty River Ammonia Plant | 40 | 3 km SW |
| Burrup Fertilisers Ammonia Plant | 40 | 3 km SW |

The King Bay Port Area is comprised of:

- the offshore support jetty at the King Bay Supply Base from which Mermaid Sound Port and Marine Services supply Woodside offshore facilities;
- the Dampier Port Authority General Cargo Jetty; and
- the Port Industrial Area.

Transportation / Service Routes include:

- Public Jetty;
- Gas Pipeline within the utilities corridor; and
- Road Transport.

### 3.1.3 Meteorology

#### 3.1.3.1 Data Sources

For the consequence modelling, suitable combinations of wind speed and stability class are chosen. These combinations must reflect the full range of observed variations in these quantities. As such combinations of wind speed and stability were grouped into representative weather classes; to cover all conditions observed. The choice of weather classes for the examination of the site is given in the following section.

The data required for the risk analysis came from the Bureau of Meteorology and was collected at the Dampier weather station. Qest then summarised and grouped the wind (speed, direction and stability) data for use in the consequence and risk modelling.

### 3.1.3.2 Processing the Data

The meteorological data provided has hourly measurements of wind speed, direction and stability coefficient for a year. The stability coefficients are detailed in Table 3.1.

The six (6) most common wind conditions, three (3) for day and three (3) for night, consisting of speed and stability coefficient are determined. Each condition has a distribution or directions covering the eight (8) points of the compass. The breakdown of wind conditions and associated fractions of time per direction are presented in Table 3.2.

***Table 3.1 : Stability Class Definition***

| Class | Type | Description |
|---|---|---|
| A | Unstable | Daytime - sunny, light winds. |
| B | Unstable | Daytime - moderately sunny, light to moderate winds. |
| C | Unstable / Neutral | Daytime - moderate winds, overcast or windy and sunny. |
| D | Neutral | Daytime - windy, overcast or Night-time - windy. |
| E | Stable | Night-time - moderate winds with little cloud or light winds with more clouds. |
| F / G | Stable | Night-time - light wind, little cloud. |

Table 3.2 shows the processed wind / weather probability data for the site used in the risk calculations.

***Table 3.2 : Meteorological Probabilities (Percentages)***

| Direction (From) | Wind | | | | | | Total |
|---|---|---|---|---|---|---|---|
| | 2.5B | 4.2C | 6.3C | 1.8F | 3.0F | 5.1D | |
| N | 0.02 | 0.02 | 0.03 | 0.01 | 0.01 | 0.02 | **0.10** |
| NE | 0.01 | 0.02 | 0.03 | 0.01 | 0.01 | 0.01 | **0.08** |
| E | 0.02 | 0.04 | 0.03 | 0.02 | 0.01 | 0.00 | **0.13** |
| SE | 0.03 | 0.03 | 0.01 | 0.03 | 0.03 | 0.02 | **0.15** |
| S | 0.02 | 0.01 | 0.00 | 0.03 | 0.02 | 0.01 | **0.09** |
| SW | 0.03 | 0.01 | 0.00 | 0.05 | 0.05 | 0.03 | **0.17** |
| W | 0.02 | 0.03 | 0.04 | 0.01 | 0.02 | 0.07 | **0.20** |
| NW | 0.02 | 0.01 | 0.01 | 0.01 | 0.01 | 0.02 | **0.08** |
| **Total** | **0.17** | **0.17** | **0.16** | **0.16** | **0.16** | **0.18** | **1.00** |

For other key meteorological parameters, averages are taken from the local data [17]. The data used was:

Ambient Temperature: 29°C (302K)
Atmospheric Pressure: 101325 Pa
Relative Humidity: 43%

## 3.2 Process Description

The proposed Methanol plant will produce 3000mtpd of Methanol product using natural gas as a feedstock, which will be available for export to outside users. This plant will be operated on a 24 hour basis and for this Study the plant is assumed to operate 365 days per year.

Two (2) pure Methanol storage tanks each with a capacity of approximately 60,000 $m^3$ will be provided. Methanol for export will be off-loaded via a specially designed loading arm to storage tankers. Approximately 36 loadouts to export of 30,000 tonnes of methanol will be required per year.

Process flow diagrams (PFD's) for the methanol plant are presented in Appendix B. The detailed process description presented below follows the sequence of PFD's.

### 3.2.1 Methanol Manufacture

#### *3.2.1.1* General

The manufacture of Methanol from natural gas is described in detail below.

#### 3.2.1.2 Process

**Unit 100 – Reforming**

The objective of the natural gas reforming unit is to produce methanol synthesis gas at suitable fractions of $H_2$, CO and $CO_2$ from the natural gas feed. The composition of methanol synthesis gas is usually characterised through the stoichiometric ratio:

$SN = (H_2 – CO_2) / (CO + CO_2)$,

In terms of molar fractions (on a wet or dry basis), Methanol synthesis is most efficient with a synthesis gas of SN about 2.0 – 2.1. This is achieved here using a suitable combination of steam and autothermal reforming.

In summary, the following steps are performed on the natural gas feed in unit 100:

- Hydrogenation and desulphurisation
- Saturation
- Pre- and steam reforming
- Autothermal (or secondary) reforming
- Reformed gas cooling

*Hydrogenation and Desulphurisation*

The sulfur components in the natural gas would poison the reforming and methanol catalysts in units 100 and 200 and therefore have to be removed. To achieve this standard catalytic processes are implemented, working at around 380$^o$C.

Before the natural gas is preheated, purge gas from the methanol synthesis loop is added. It provides the hydrogen required for hydrogenating the organic sulfur components in the feed.

First hot purified natural gas of 380°C coming from the desulphurisation heats the cold natural gas to 320°C. Final preheating to 380°C occurs in the natural gas preheater in the flue gas waste heat system of steam reformer.

The hot gas passes through a hydrogenation reactor containing a cobalt molybdenum based catalyst. Organic sulfur components are converted to $H_2S$.

The $H_2S$ content of the gas is then reduced to less than 0.1 vol.-ppm as required for the downstream processes through conversion to ZnS when passing the ZnO catalyst in two zinc oxide vessels. These reactors are passed in a row and their sequence may be changed. One reactor may be taken offline for changing the catalyst with the other one in service at 100% plant load.

*Saturation*
A significant part of the process steam needed for reforming is added to the purified gas feed as water in a saturator absorber column. The almost dry gas enters the column bottom and leaves the top at about 210°C. Most of the water added in the saturator is process condensate knocked out in the reformed gas cooling train and process water separated from the crude methanol in distillation unit 300.

The advantages of this saturation step are:
- Reduced demand of vapour phase process steam
- Reduced capacity of process condensate treatment
- Reduced capacity of process waste water treatment

*Reforming*
After purification and preheating, the conversion of the natural gas feed to CO, $CO_2$ and $H_2$ is performed in different reforming steps.

*Prereforming*
The saturated feed is first preheated to 510°C in a feed preheater in the reformed gas cooling train and the flue gas waste heat system. Part of the stream is directly routed to the secondary reformer. The remaining part is mixed with process steam and sent to the prereformer. A major advantage of prereforming is the low allowable steam / carbon ration which is only 1.4 in this case.

The prereformer is a simple adiabatic fixed bed reactor where hydrocarbons heavier than methane are cracked so that only methane, $H_2$, CO, $CO_2$ and steam (and some $N_2$) are present at the reformer outlet. Lurgi and BASF have jointly developed this process stage already in the early 1960's for converting naphtha into a methane-rich gas. The prereformed gas is therefore also called rich gas. Early applications were for producing town gas and later also CO rich synthesis gases. However, it is useful also for steam reforming of natural gas, because it reduces the size of a downstream steam reformer and leads to more favourable operating conditions.

*Steam Reforming*
After adding process steam the prereformed gas is superheated to 560°C in the flue gas waste heat system of the steam reformer and fed to the primary reformer.

A single top-fired Lurgi steam reformer with 240 tubes is used. The burners are installed in rows in the ceiling of the firebox burning a mixture of natural gas and offgas from the pressure swing adsorption unit (PSA). A combustion air blower supplies combustion air to the burners. The firebox is kept at a slight vacuum using a flue gas fan. Both fans are turbine-driven.

*Autothermal Reforming (Secondary Reforming)*
The top section of a secondary reformer holds a burner where the feed gas is mixed with oxygen and steam preheated to 230°C. Part of feed gas is burnt generating heat to further promote the reforming reactions. The amount of oxygen is adjusted in a way that the gas mixture leaves the bed of reforming catalyst below the combustion zone at 975°C. At this temperature nearly 97% of the dry reformed gas are $H_2$, CO and $CO_2$. The (dry) residual methane content is less than 2%. There is also more CO than $CO_2$, which is favourable for methanol synthesis.

A water-cooling jacket keeps the cylindrical shell surface at a uniform temperature independent of weather conditions.

*Reformed Gas Cooling*
The hot reformed gases leaving the secondary reformer are immediately routed to waste heat boilers through short pieces of refractory lined transfer lines. These boilers generate saturated HP steam (104 barg) at normal operating conditions. The boilers are connected through risers and downcomers with a steam drum forming a natural water-steam circulation system.

The reformed gas leaving the waste heat boilers is further cooled in the feed preheater where saturated natural gas feed from the saturator is heated to 380°C on the shell side. Cooling to about 165°C is achieved in the circulation water heater where water of the saturator loop is heated to 240°C on the shell side.

The reformed gas is then routed to the gas reboilers in the distillation unit and ensuite to the demineralised water preheater. Process condensate is removed in separators.

The reformed gas is further cooled by aircooling, and a final water cooler to 40°C. Process condensate is knocked out in separators.

The major part of the collected process condensate is recycled back to the saturator. The remaining process condensate is routed to unit 500 for treatment.

*Reformer Flue Gas Cooling*
The hot flue gas leaving the reformer firebox is a huge source of energy to be recovered. Several bundles are arranged in the flue gas duct to allow an optimum heat recovery.

The hottest bundles in the system are used for preheating the reformer feed to 560°C. The steam reformer inlet temperature is controlled through boiler feed water quench.

The following heat exchanger is the prereformer feed with a tube side outlet temperature of 510°C. Again this temperature is controlled through addition of boiler feed water upstream of the bundle.

Downstream of the prereformer preheater auxiliary burners are located in the flue gas channels. They boost the flue gas temperature to about 900°C. This results in reasonable temperature differentials and surface areas of the downstream heat exchanger bundles.

The remaining energy is used subsequently for HP-steam superheating, MP-steam superheating, natural gas preheating, process condensate heating and combustion air preheating.

**Unit 200 – Methanol Synthesis**

*Synthesis and Recycle Gas Compression*
The reformed gas routed to the methanol synthesis unit is mixed with hydrogen from the PSA to adjust the stoichiometric ratio to 2.05. This gas is compressed to about 75 barg using a single casing centrifugal compressor.

Recycle gas is the major part of the remaining vapour phase after the methanol reactor effluent has been cooled and the liquid crude methanol been removed. To make up the pressure drop in the synthesis loop the recycle gas needs to be re-compressed using a recycle gas compressor. Both compressors are driven by a single steam turbine. This turbine is one of two major steam turbines consuming the superheated HP steam generated in unit 100 and 1400. The turbine has extraction at the MP steam level for process steam. The balance steam is condensed.

*Methanol Synthesis Reactors*
Methanol is synthesised from $H_2$, CO and $CO_2$ using a highly selective copper based catalyst. The two basic and very exothermic reactions are:

$$CO + 2H_2 \Leftrightarrow CH_3OH$$

$$CO_2 + 3H_2 \Leftrightarrow CH_3OH + H_2O$$

For large capacities Lurgi has developed a two-stage reactor system.

The first stage is the classical water-cooled reactor known from any Lurgi plants with capacities up to 2500 mtpd of methanol. The heated synthesis and recycle gas passes the catalyst tubes of a water-cooled methanol reactor. The heat of reaction is removed from the catalyst tubes through boiling water on the shell side of the reactors generating MP-steam.

The effluent of the first stage is then routed to a gas-cooled reactor passing the catalyst on the shell sides. In this case the heat of reaction, which is less than in the first stage, is absorbed through synthesis and recycle gas flowing on the tube side. This reactor resembles the gas-gas interchanger of classical Lurgi methanol units where the hot methanol reactor outlet gas flows on the tube side heating up the reactor feed on the shell side.

*Reactor Outlet Gas Cooling*
The effluent from the second reaction stage has a temperature of approx 220$^o$C and is of vapour phase. Crude methanol is recovered from this gas through cooling and condensation.

First the gas passes the HP boiler feed water preheater heating the water to about 180$^o$C. Further gas cooling including heat recovery occurs in a trim heater and the MP-BFW preheater.

Finally cooling is undertaken by aircooling and final water cooling to 40$^oC$. The condensed crude methanol is separated from the gas phase in the methanol separator.

*Purge Gas*
A fraction of the vapour phase is purged from the loop. Otherwise inert components such as methane and nitrogen would build up in the loop. Most of it is routed to the PSA unit, where hydrogen is recovered and recycled to the suction of the syngas compressor. The rest is mixed with the natural gas feed supplying $H_2$ for hydrogenation.

**Unit 300 – Methanol Distillation**

A prerun column and two pure methanol columns operating at different pressures are the main components of the methanol distillation unit. The overhead vapours of the pure methanol pressure column are used to heat the reboiler of the pure methanol atmospheric column reducing the heating steam demand of the unit.

Apart from methanol, the crude methanol produced in the synthesis unit contains water, solved gases and small quantities of undesirable but unavoidable impurities, which may have higher or lower boiling points than methanol.

The distillation unit serves to remove these impurities at low loss of methanol and low steam consumption with the pure methanol product meeting the given grade AA specification. This is achieved in the following process steps:
- Degassing
- Removal of low-boiling impurities
- Removal of high-boiling impurities

*Degassing*
Crude methanol is flashed from synthesis pressure of about 67 barg to about 4.5 barg in an expansion vessel. The flash gases ($CO_2$, CO, $H_2$, $CH_4$, $N_2$ and some methanol) are released through a pressure control valve and are mixed to the fuel gas of the steam reformer. The flashed crude methanol is routed to the distillation process.

The vessel is level controlled. Surplus of crude methanol is discharged to the crude methanol tank in unit 400 whereas a deficit is made up from the same tank.

*Prerun Column*
The degassed crude methanol is fed flow controlled to the prerun column. The residual solved gases and low boiling by-products (mainly dimethylether and methylformate) are removed overhead together with some methanol vapour. The overhead vapour passes through the air-cooled prerun column condenser, where most of the methanol vapour is condensed.

The condensate is collected in the prerun column reflux vessel, removed from this vessel on level control and recycled to the column top. The uncondensed vapours are cooled further in an off gas cooler where some more methanol condenses from the off-gas. This condensed methanol runs back while the off-gases are heated and mixed to the steam reformer fuel.

A small quantity of caustic is fed to the column to prevent corrosion in the columns.

During normal operation, the reformed gas reboiler provides the reboiler duty for the prerun column. A steam reboiler is used for start-up and is heated with LP steam of 4.5 barg.

The stabilised methanol – free of low boiling impurities – leaves the bottom of the prerun column through a level control valve and is pumped to the pure methanol pressure column.

*Pure Methanol Column*
High boiling impurities – mainly higher alcohols and water – are separated from methanol in the pure methanol pressure column and the pure methanol atmospheric column. The overhead vapours are condensed in a reboiler/condenser where the heat released is utilised for boiling the bottoms of the atmospheric column.

Distilled liquid methanol is collected in the pressure column reflux vessel. Part of it is recycled to the column top. The balance is further cooled in the pure methanol cooler and routed to one of the shift tanks in unit 400. The pure methanol column has two steam reboilers heated with LP steam reformed gas respectively.

The remaining methanol containing high boilers is withdrawn level controlled from the bottom of the pressure column and fed to the pure methanol atmospheric column.

*Pure Methanol Atmospheric Column*
The pure methanol atmospheric column operates little above atmospheric pressure and produces pure methanol overhead. The bottom product is more than 99 wt-% pure water. The overhead pure methanol vapour of the column is condensed in an air-cooled atmospheric column condenser and then subcooled using cooling water in pure methanol cooler. The cooled pure methanol is collected in the atmospheric column reflux vessel. Part of the methanol is recycled to the column top and the balance is sent to shift tank in unit 400 as product.

The bottom stream of the column is process water containing only about 0.1 wt-% of alcohols. This process water is fed to the saturator system in unit 100.

**Unit 150 – Steam and Condensate System**

The plant's steam system features the following headers:
- superheated HP steam (101 barg, 510$^{o}$C)
- saturated MP steam (45 barg, 259$^{o}$C)
- superheated MP steam (43 barg, 390$^{o}$C)
- de-superheated LP steam (4.5 barg, 160$^{o}$C)

*HP Steam*
During normal operation HP steam is produced in unit 100 in the waste heat boilers where reformed gas is cooled from 975$^{o}$C to 480C. The Boiler feed water supplied to the boilers is preheated in the methanol synthesis loop. The rest of the HP demand is covered by the auxiliary boiler in unit 1400. The total HP-steam is superheated to 510$^{o}$C in the reformer flue gas waste heat system.

HP superheated steam is consumed in unit 200 by the steam turbine driving the syngas compressor, in unit 1300 by the steam turbine used in the air separation plant and used for power generation.

*MP Steam*
MP Steam is generated in the water-cooled methanol reactor of unit 200 and superheated in the flue gas waste heat system to 390°C. A small part of the saturated MP-steam is used for oxygen preheating. The superheated MP-steam is mainly used for driving various backpressure steam turbines in the plant.

*LP Steam*
Normally LP steam comes from the turbines. As all come with different temperatures above the header temperature the combined LP turbine steam must be quenched to 160°C. LP steam is consumed in unit 300 for heating the pressure column steam reboilers.

*Boiler Feed Water Preparation*
All the plant's steam generators are supplied from the boiler feedwater drum. HP boiler feed water is pumped to unit 100 and unit 1400 by HP boiler feed water pumps. HP BFW is also used for quenching various process and steam streams. MP BFW is transferred to unit 200.

Most of the consumed BFW is made up from directly recycled turbine condensate and from unit 300 LP steam condensate. The balance is demineralised water from boiler feed water treatment unit 500. Some LP heating steam is used to keep the drum at the bubble point.

**Unit 400 – Intermediate Methanol Tank Farm**

Two pure methanol shift tanks alternatively provide intermediate storage for the methanol product from the distillation section during each shift. While one tank is filled with methanol from the plant, the contents of the other is sampled and checked for purity. When the sample is "on-spec", it is approved and the contents pumped to pure methanol storage tanks in unit 1100. Otherwise the "off-spec" product is routed to the crude methanol tank and reprocessed in the distillation section together with crude methanol from the methanol synthesis unit.

Apart from storing off-spec methanol, the crude methanol tank serves as a buffer between the methanol synthesis and distillation unit and can accommodate temporarily different production rates of both units.

**Unit 500 – Boiler Feed Water Treatment**

The process condensate of unit 100 is treated in unit 500 using ion exchangers and a degasser. The pretreated water is mixed with parts of the fresh water from B.L. and routed via two parallel mixed bed filters. The demineralised water produced in unit 500 is sent to the boiler feedwater drum in unit 150 for further distribution.

**Unit 550 – Sea Water Desalination**

The sea water desalination unit 550 serves to produce the required make-up for the sweet cooling water system and balances the water consumed in the reforming process. Most probably a flash-type evaporation will be used.

**Unit 600 – Sweet Cooling Water System**

A closed sweet cooling water system – cooled back with sea water – is used.

**Unit 650 – Sea Water System**

The seawater in-take system is located at the coast. It is equipped with screens and a blow back system, which allows periodic cleaning of the screens. The seawater is pumped from the in-take to the desalination unit 550 where it serves to produce the desalinated water required in unit 500 and 600.

**Unit 700 / 750 – Power Generation**

The power required in the plant is produced in unit 700 using a turbine generator. The steam turbine driving the generator is fed with HP superheated steam. During emergency upsets a diesel driven power generator is used to provide the necessary power to restart the plant.

**Unit 800 – Instrument and Plant Air System**

Unit 800 provides Instrument and Plant Air to the plant. In case of failure of the instrument air compressor a buffer vessel will ensure the instrument air supply for approx 30 min. allowing reasonable time to restart the compressor.

**Unit 900 – Waste Water Treatment**

The Waste Water Treatment is mainly used for treating the sanitary sewage of the plant. Depending on statutory requirements the blow down from the saturator, which may contain minor traces of organic compounds, will be treated as well.

**Unit 1000 – Flare System**

During the start-up of the plant, when safety valves on lines or vessels containing flammable gases blow off or during sudden shutdowns there are gas streams which have to be routed to the flare.

The flare is a hot-type flare which is ignited by continuously burning pilot burners fed with natural gas. Nitrogen is used as seal gas. Condensate is collected in a flare knock out drum located at the bottom of the flare and discharged via a slop pump.

**Unit 1100 – Methanol Product Tank Farm and Ship Loading**

The Pure Methanol Storage Tanks have a capacity of approximately 60,000 $m^3$ each. Pure methanol is pumped with transfer pumps from the tank farm to the ship loading arms.

**Unit 1200 – Fire Fighting System**

The proposed fire fighting system includes a water storage tank, pumps, main fire ring equipment like hydrants, hose cabinets, fire extinguishers, etc. A fire alarm system and sprinkler system will be installed in the administration building.

The final design for the plant will incorporate all fire fighting systems to make the plant as safe as practicable, but at the early stage of design which is available for this study the fire fighting systems have not been finalised.

**Unit 1300 – Air Separation Unit**

The oxygen blown secondary reformers are essential for the full methanol capacity and proper performance of the plant.

Oxygen is the main product of the air separation unit and produced in a cryogenic distillation process. Nitrogen is another product of the unit and mainly needed for methanol tank blanketing in units 400 and 1100. During start-up and shut down of the plant nitrogen is needed as general utility.

**Unit 1400 – Auxiliary Boiler System**

During normal operation the auxiliary boiler will produce superheated HP-steam to make up the requirements for the syngas turbine, the steam turbine of the air compressor in unit 1300 and the power generator. The major producer of HP superheated steam in normal operation is unit 100. During start-up unit 1400 will solely ensure power and steam supply for the plant.

The auxiliary boiler will be a natural circulation type boiler fired with natural gas in a pressurised furnace. A forced draft air is used to supply combustion air, making a flue gas blower unnecessary.

**Unit 1600 – Rainwater Sewer System**

Rainwater is collected in a drain system. The collected rainwater will be pumped to suitable battery limit.

### 3.2.2 Methanol Storage

It is proposed that two 60,000 $m^3$ pure Methanol storage tanks would be installed adjacent to the intermediate storage tanks. The Methanol will be stored as a liquid at atmospheric pressure and temperature.

The approximate dimensions of each storage tank will be overall diameter 60m and height 21m.

It is proposed that both tanks will be single walled. Other design safety features common to all contemporary atmospheric Methanol storage installations will also be incorporated.

### 3.2.3 Export Systems

#### 3.2.3.1 Liquid Methanol Export

Dedicated export pump(s) will be provided to transfer Methanol from the Methanol storage tank(s) to ship loading facilities via a 24” pipeline at a maximum rate of 1500 tonnes/hr. The pipeline route is shown on the location map provided in Figure 3-1. The pumps will be provided with instrumentation to detect abnormal conditions such as low discharge pressure and seal leakage and will be connected to an Emergency Shutdown (ESD) system. Off-loading to tankers is expected to occur approximately 36 times per year, with each transfer taking approximately 20 hours.

The Methanol product pipeline will be situated on the underside of the new loading wharf to the ship loading point. Loading of the ship will be undertaken with the use of a specially designed marine loading arm, capable of loading up to 1500t/hr. The flexible arm will be connected to the permanent product pipeline. The ship will also comprise permanent piping with a flexible attachment to allow for the rise and fall of the ship due to changes in tide and the sinking of the ship as it becomes increasingly heavier as it is loaded.

The Methanol loading process is activated from the plant site. Once complete, the pipeline will remain full of methanol and will not be emptied.

The ships that will be required to export Methanol are likely to be 50,000 t ships capable of storing approximately 30,000 t of liquid Methanol.

The slops tanks and the associated nitrogen supply for this tank are to be located on the shore near the approach to the wharf deck. The slops tank has been designed on the basis of retaining 30 seconds of full flow in the event of a surge relief. This represents a total tank volume of 25 $m^3$.

Once the ship is loaded, the supply of Methanol from the plant site is terminated and the valves of the loading arms are closed.

### 3.2.4 Natural Gas Pipeline

The natural gas feedstock for the Methanol plant will be provided via the DBNGP, which extends from the Woodside LNG plant entering at the north west of the proposed plant site. It is assumed that gas will be supplied at battery limits at approximately 6.0 MPag.

### 3.2.5 Environmental Considerations

A full assessment of environmental impacts is beyond the scope of this PRA report, however the plant will be designed and constructed to meet contemporary effluent and emission standards with particular consideration to local regulations governing environmental protection. A modern Methanol plant is a chemical manufacturing installation with very limited impact on the surrounding environment.

Gaseous emissions will be within acceptable limits and will not cause air pollution nuisances or hazardous conditions for the neighbourhood. Liquid discharges will be within acceptable limits and will not pollute the sea or other waters with wastes which would contribute excessive quantities of dissolved or suspended solids, oil, harmful or oxygen depleting chemicals or coloured material. Provision will be made to ensure that any process spills are collected and treated as required. No toxic or hazardous materials will be discharged from the plant.

***Figure 3-1 Methanol Plant Proposed Site Location***

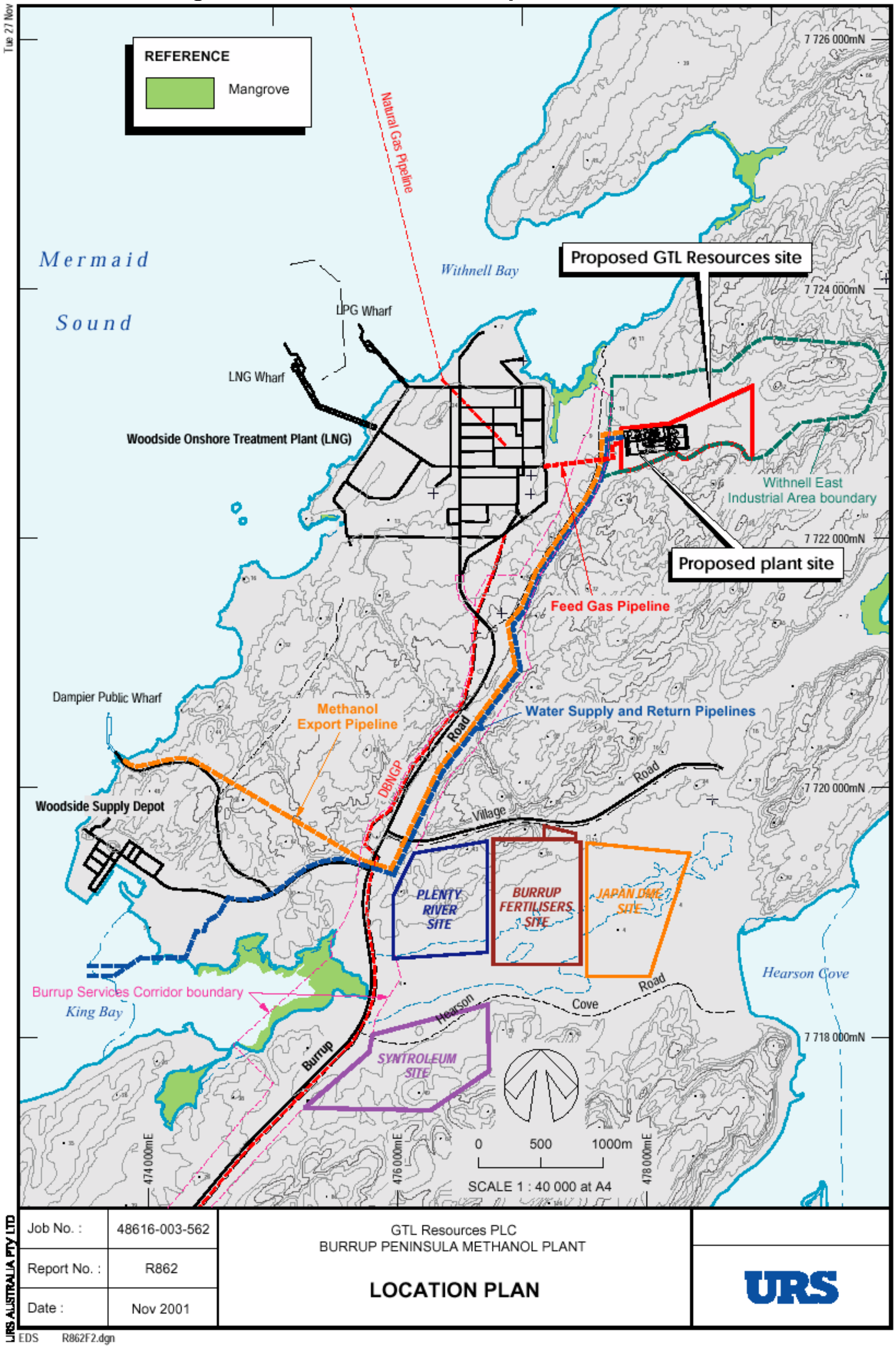
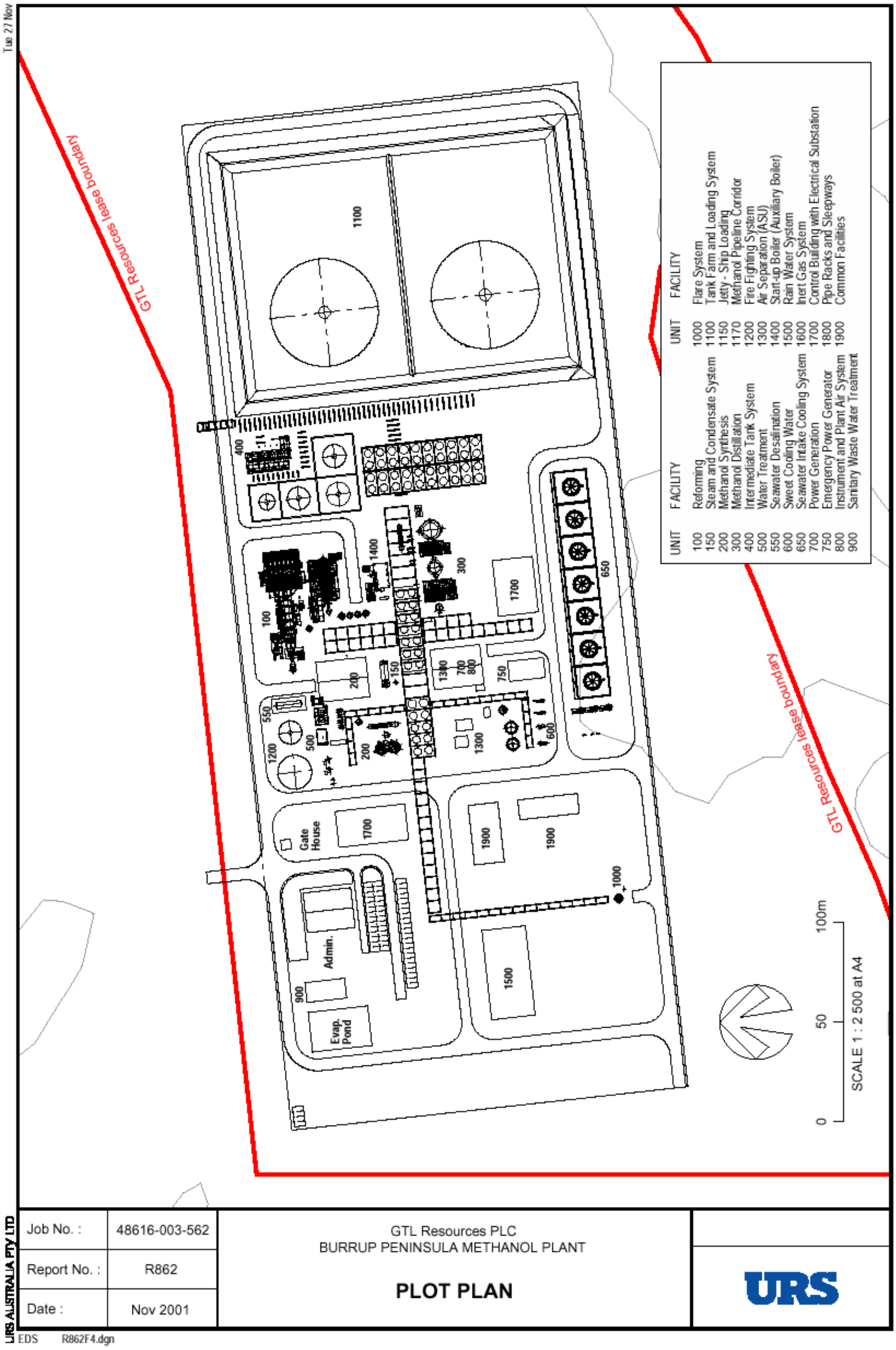


***Figure 3-2 Methanol Plant Proposed Site Layout***



# 4 HAZARDS ASSOCIATED WITH THE PROPOSAL

## 4.1 Properties of Process Materials

From reviewing preliminary process information, the following process materials are of interest in this study:

- Methanol;
- Methane (in natural gas);
- Carbon monoxide;
- Oxygen;
- Hydrogen; and
- Various catalysts.

## 4.2 Potential Hazards Associated with Methanol Plant

### 4.2.1 In-Plant Hazards

Principal hazards encountered in a Methanol plant may be grouped as follows:

- Chemical: particularly Methanol, methane and hydrogen (see 4.2.2 below for details).
- Operating Conditions
- Pressure System Components:
  - Furnaces
  - Compressors
  - Air Separation Unit

For a Methanol plant, the materials required to handle the above operating conditions are well understood, and covered by the relevant engineering codes and standards.

### 4.2.2 Chemical Hazards

As this preliminary risk analysis is primarily concerned with the impact of the facility on the surrounding environment and population, discussion of hazardous events will focus on those chemicals which will be present in quantities large enough to cause potential problems outside the site if a release occurs.

Appendix F describes the detailed properties of process materials to be used at the facility. The physical and chemical properties of these materials and, where relevant, flammability and toxicity data are also detailed.

The main hazards will arise from the loss of containment of pressurised gases or flammable liquids. Resulting vapour clouds mixing with air will be dangerous, both from the potential environmental effects of the spreading material and also from the possibility of a flammable mixture being ignited.

#### 4.2.2.1 Methanol

Methanol (Methyl Alcohol) is a clear, colourless flammable liquid (and vapour) with a faint characteristic alcohol odour. It is a moderate explosion hazard and dangerous fire hazard when exposed to heat, sparks or flames. It has a boiling point of 65°C and a flash point of 11°C. Above flash point, vapour/air mixtures are explosive within 6 to 36.5% vol. in air. There is potential for rupture of sealed containers when heated. Methanol is sensitive to static discharge.

Methanol is harmful / life-threatening if ingested or absorbed through the skin. Excessive heating and/or incomplete combustion will generate highly poisonous CO and $CO_2$.

In the event of an ignited release, a methanol fire may not be visible to the naked eye.

The TLV of methanol is 200 ppm, and IDLH is 25000ppm.

Methanol is highly reactive with strong oxidisers and should not be stored or mixed with the agents such as nitrates, perchlorates or sulfuric acid. If methanol is released on to soil it is readily biodegradable and would quickly evaporate. Methanol is completely soluble in water. However if released into water, it will be slightly toxic to aquatic life.

At the proposed plant, bulk storage will be in two atmospheric 60,000 $m^3$ vessels. Liquid methanol will also be present at various combinations of pressure and temperature in other intermediate stages of the process plant.

Sections of the process where methanol may be present as vapour are also examined. However, the quantities are generally small compared with liquid inventories and the releases are likely to be less dense.

In Section 6, the identified (possible) methanol release events are modelled as part of the consequence and risk level assessment.

#### 4.2.2.2 Methane

Methane is not stored on site but is present as the principal component of the natural gas feed. It is also present in (reducing) quantities in the desulphurisation and reforming sections of the Methanol plant.

A large release of methane may result in the formation of a cold dense cloud due to a large reduction in pressure following an inadvertent release to atmosphere.

Methane is not toxic except as a simple asphyxiant. It is flammable between 5 and 15% (vol.) in air. When unconfined it is not explosive.

#### 4.2.2.3 Hydrogen

Hydrogen exists in varying quantities as a product of the reforming process throughout the methanol facility presenting the potential for explosions either internal (resulting from ingress of air) or external (from leaks). The impact of such explosions is likely to be local, however the secondary or domino effects (such as damage to a liquid methanol vessel) could result in offsite harm.

#### 4.2.2.4 Carbon Monoxide

This gas is present in sufficient amounts post reformer to warrant quantification of offsite risk. It is also possible that it can impose an occupational risk to personnel working in the area.

Carbon monoxide is a toxic gas (by inhalation) with no obvious warning properties as it decreases the ability of the blood to carry oxygen to the tissues. Since it is odourless, colourless, and tasteless, unanticipated overexposure to this highly dangerous gas can readily occur.

Although carbon monoxide has not been found to be carcinogenic in humans, it is a chemical asphyxiant that exerts its effects by combining preferentially with haemoglobin (the oxygen-transport mechanism in blood) thereby excluding oxygen. Some symptoms of exposure to CO at 500 to 1000 ppm include headache, palpitations, dizziness, confusion and nausea. Loss of consciousness and death may result from exposure to concentrations 4000 ppm and higher. High concentrations may be fatal without producing any significant warning symptoms.

#### 4.2.2.5 Nitrogen

The liquid nitrogen from the Air Separation Unit facilities is used for purging from the process equipment. This can present some risk to personnel involved.

Nitrogen is an odourless, tasteless, colourless, inert gas and personnel that come in contact with large concentrations of nitrogen will have difficulty breathing. It is sometimes stored as a liquid and personnel who come in contact with it can suffer severe burns and lacerations due to extremely low temperatures.

Short term exposure via inhalation cases effects such as nausea, vomiting, drunkenness, tingling sensation, suffocation, convulsions, and possibly coma.

#### 4.2.2.6 Oxygen

Oxygen is not being stored, but is being produced on demand by the Air Separation Unit. The extreme cold provides an on-site local risk.

Oxygen release would increase the thermal effects of any flammable scenario, but it is not flammable or toxic in its own right.

#### 4.2.2.7 Catalysts

The process catalyst materials could be sourced from a number of companies. These substances do not pose any particular hazard during normal operation, although precautionary measures are necessary to minimise dust exposure during handling.

| Location | Composition |
|---|---|
| ***Reforming:*** | |
| Hydrogenation | CoMo based |
| Desulfurization | Zinc Oxide |
| Prereforming | Ni based |
| Steam reforming | Ni based |
| Autothermal reforming | Ni based |
| ***Synthesis:*** | |
| Methanol synthesis | CuO/ZnO |

#### 4.2.2.8 Operability Hazards
In-plant failures leading to the releases discussed above could be caused by:
- mechanical or material failures;
- utility failures;
- operational mishaps; and
- start-up / shut-down mishaps.

Detailed treatment of operational failure causes will be covered in Hazard and Operability (HAZOP) studies carried out when detailed design information and drawings are available. For this preliminary analysis, frequencies of potential hazardous events are estimated using historical failure rates for mechanical or material failures.

### 4.2.3 Product Export

#### 4.2.3.1 Methanol Export
Failure of the methanol export pipeline will result in the release of methanol on land. A failure of the marine loading arm will lead to a spill of methanol on the jetty, ship or water. Methanol is readily miscible in water, thus spills onto water would rapidly diffuse into the water, and maybe toxic to aquatic life.

#### 4.2.3.2 Shipping Hazards
There will be 36 export ship movements per year. The likelihood of an incident is discussed in Section 6.5.5.

#### 4.2.3.3 Other Risk Events

**Aircraft Risks**
Commercial aircraft are not allowed to fly over the industrial area, therefore aircraft risk to the proposed methanol plant is negligible. Small aircraft may occasionally fly over the site and could present a crash risk. The resulting frequency of this event is likely to be very small and is considered not to present a significant increase in risk levels to the plant.

**Earthquake**
To minimise potential earthquake damage Australian Standard 1170.4 1993 will be used to determine the minimum level of design.

**Cyclone**
This is a cyclone affected region and the facilities will be designed according to the Australian Standards (AS 1170.2). In the event of a cyclone, personnel would evacuate in accordance with the Emergency Management Plan.

## 4.3 Review of Operating Philosophy and Safety Management

### 4.3.1 History of Similar Facility & Lurgi Technology

Lurgi Oel · Gas · Chemie GmbH designs and builds turnkey plants for the product lines of Hydrocarbon Technology, Gas Technology and Petrochemistry. Hydrocarbon Technology includes the processing of crude oil and production of aromatics in refineries. In Gas Technology, Lurgi offers its proprietary processes for synthesis gas production, for sulfur recovery and methanol synthesis and, in cooperation with Ammonia Caseale, also ammonia synthesis. In the petrochemical sector, the company boasts significant know how with processes for producing monomers, polymers – such as PVC and rubber – and petrochemical feedstocks like acetic acid.

**Advantages for the Methanol Synthesis**
The special advantages of the combined converter synthesis (2-stage reactor concept) of Lurgi compared to conventional technologies are:

- Higher syngas conversion per cycle and, as a result, a circulation system on a lower scale
- Generation of 50 bar high-pressure steam
- Reduction of capital expenditure by 30 to 40 %
- Suitability for very high capacities (over 5000 t methanol per day and train)
- Increase of catalyst service life
- Boost in the capacity of existing plants

**Lurgi Methanol Plants**

| Year Built | Location | Feed Stock | Capacity (t/y) |
|---|---|---|---|
| 1969 | Germany | Cracker Residue | 5000 |
| 1970 | Germany | Vacuum Residue | 220000 |
| 1971 | Austria | Natural Gas Naphtha | 77000 |
| 1971 | Taiwan | Natural Gas | 50000 |
| 1973 | Italy | Natural Gas | 50000 |
| 1974 | USA | Natural Gas | 410000 |
| 1975 | Mexico | Natural Gas | 150000 |
| 1976 | USA | Heavy Residue | 605000 |
| 1976 | Slovenia | Natural Gas Naphtha | 200000 |
| 1977 | Taiwan | Natural Gas | 10000 |
| 1977 | Germany | Vacuum Residue | 365000 |
| 1978 | China | Vacuum residue | 100000 |
| 1979 | USA | Natural Gas | 375000 |
| 1979 | USA | Natural Gas + $CO_2$ | 390000 |
| 1979 | USA | Natural Gas + $CO_2$ | 810000 |
| 1979 | USA | Naphtha + Refinery Off-Gas | 300000 |
| 1980 | USA | Coal | 180000 |
| 1981 | Malaysia | Natural Gas | 660000 |
| 1981 | USA | Coal | 6000 |
| 1981 | Brasil | Vacuum Residue | 8000 |
| 1982 | Germany | Vacuum Residue | 700000 |
| 1982 | Indonesia | Natural Gas | 330000 |
| 1982 | Burma | Natural Gas | 150000 |

| Year Built | Location | Feed Stock | Capacity (t/y) |
|---|---|---|---|
| 1982 | Iran | Natural Gas | 85000 |
| 1985 | India | Naphtha | 65000 |
| 1991 | USA | Natural Gas | 82500 |
| 1992 | Norway | Oil Associated Gas | 830000 |
| 1992 | USA | Natural Gas | 550000 |
| 1993 | China | Natural Gas | 100000 |
| 1994 | Indonesia | Natural Gas | 660000 |
| 1995 | Iran | Natural Gas | 660000 |
| 1996 | South Africa | Coal Gas | 140000 |
| 1997 | Trinidad | Natural Gas | 850000 |
| 1998 | Kuwait | Natural Gas | 660000 |

#### 4.3.2 Safety Standards and Features to be Incorporated

Incorporation of safety standards and features starts with the selection of technology. During all phases from engineering through to procurement and construction, quality assurance systems will be in place to ensure that the designed plant safety features are implemented correctly.

Automatic shutdown of the plant, or parts thereof, will be initiated if certain limit values of operating parameters are exceeded. In addition, emergency manual trip initiation will be provided at strategic locations. The trip system will be designed to be fail safe, ie. failure of trip system elements or unintentional interruption of trip system signals will result in the plant or plant sections being automatically brought to a safe shutdown status.

To ensure that release sizes are minimised an Emergency Management Plan will be put in place. This will provide a plan for rapid response to identified releases, and would facilitate early manual isolation of any leaking equipment.

#### 4.3.3 Process Shutdown / Control

The shutdown process of the GTL Methanol Plant, during an emergency, will result in an emergency shut down in Unit 100, where the natural gas supply is closed and steam is admitted to the system via 010-P01. The pressure of the steam is as indicated on the PFD's 37.5 bar. The pressure of the system is then gradually reduced to approx. 2-5 bar by control of PV 031. If the plant is shutdown completely, steam is continously fed to the reformer while the temperature is gradually lowered. When the temperature is low enough, steam is replaced by nitrogen until the system cools down to ambient. The complete procedure takes approx. 12-24 hours.

The only isolating valves located in the section are for the make-up and recycle compressor.

The overall process control philosophy, from concept to actual plant operation, will be developed by Lurgi. They will also develop the control strategy, control systems and operator interface as well as selecting the proper field instrumentation.

##### 4.3.3.1 Methanol Plant Flare System

Under normal operating conditions, gas is purged from the synthesis loop. This gas, which contains nitrogen with quantities of hydrogen, methanol, methane and oxides of carbon, is passed to the fuel gas system and is not flared. During certain process upsets and emergency situations the plant will be depressurised to flare. The flare stack will be designed and positioned to minimise safety risk to the workforce, plant equipment and the natural environment.

Under emergency conditions, the plant safety system provides for a blowdown condition in the worst case. Under a blowdown condition, the whole plant or sections of the plant may be discharged to atmosphere through the flare. When it does, the inventory of the plant is released under controlled conditions to the flare. This event will discharge less than one day's normal emissions to the atmosphere in the form of a typical flare discharge composition. The precise amount of discharge depends upon the plant inventory, which will be known only when the plant is substantially designed.

It must be noted that the likelihood of a flare-out (extinguished flare) during a major upset is extremely remote.

#### 4.3.3.2 Nitrogen Purge Facilities

Liquid nitrogen storage and manufacturing facilities will be included as a plant utility used for cooling, inerting/purging flammable and other gases from process equipment and in process startup.

#### 4.3.3.3 Fire Fighting Facilities

Fire Fighting Facilities will be provided for the supply and distribution of fire fighting water for the whole plant.

#### 4.3.3.4 Emergency Response

An Emergency Management Plan will be developed as an integral part of the plant operating procedures.

#### 4.3.3.5 Safety Management and Training

A Safety Management System and appropriate procedures will be developed in conjunction with appropriate personnel. To ensure the safe operation of the facility, this will also include emergency procedures.

### 4.3.4 Engineering Codes and Standards

The plants will be designed and constructed in accordance with relevant Australian codes and standards. Where suitable Australian standards do not exist, other internationally recognised standards such as German or U.S. standards will be applied.

# 5 RISK ASSESSMENT METHODOLOGY

## 5.1 Introduction

The objective of a Preliminary Risk Assessment (PRA) is to demonstrate that, as far as is reasonably practicable, all credible accident events that have the potential to cause fatalities off site have been identified and the EPA Criteria for the assessment of risk from industry has been met [5].

The methodology used for the PRA is based on hazard scenario identification, analysis and assessment carried out in well-defined stages. The methodology follows the philosophy laid down in the Guidelines for a Preliminary Risk Assessment [6] from the Department of Environmental Protection (DEP).

The stages in the risk assessment methodology are summarised in Figure 5-1 and given in an overview below:

***a*** ***Hazard Identification:***
Identification of credible hazardous events for the facility. This is done using the analysts' experience, the design engineers engineering knowledge, experience and a systematic review of the proposed plant.

***b*** ***Consequence Analysis:***
Analysis of hazardous events identified to define causes and consequences. The following analyses are performed:

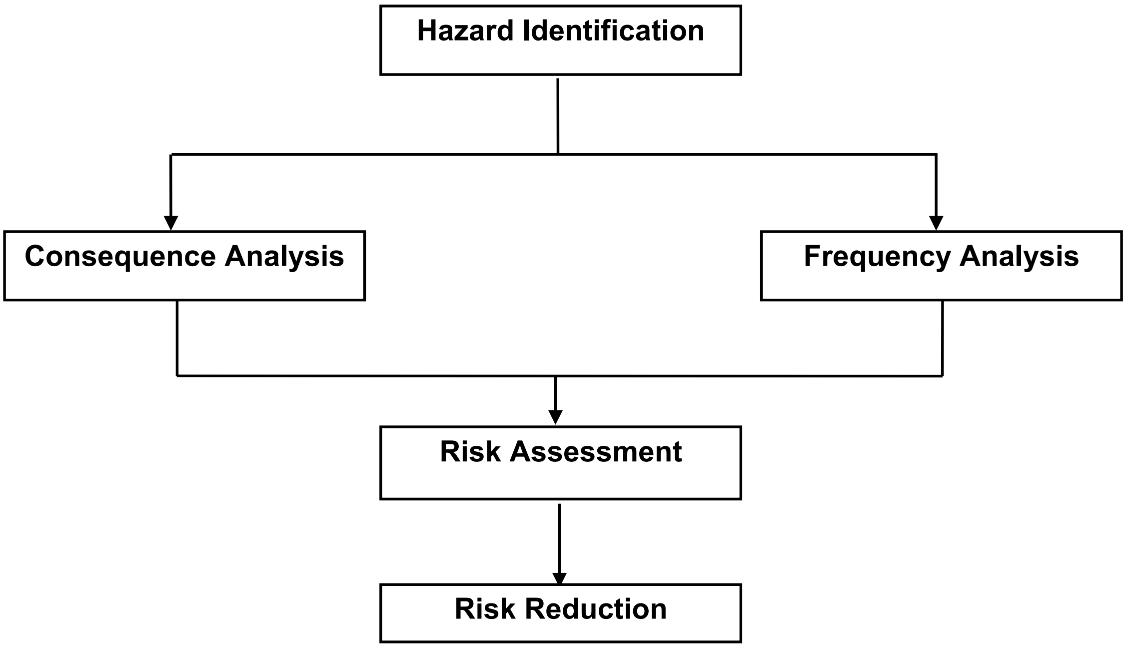
- Fire Analysis;
- Toxic Release Analysis; and
- Pipeline and Transportation Hazards Analysis.

***c*** ***Frequency Analysis:***
To determine the frequency at which the hazardous events may occur.

***d*** ***Quantitative Risk Analysis:***
Quantification of the risk arising from all hazardous events by cumulatively combining the frequency and consequence for each event.

***e*** ***Assessment of the total project risks by comparing them to the EPA guidelines (Bulletin 611) [5].***

***Figure 5-1 : Preliminary Risk Assessment Process***




The Methodology to be adopted for each of the steps 1 - 5 listed above is described in the following sections.

## 5.2 Hazard Identification

The objective of the Hazard Identification process is to systematically examine the plant and facilities in order to identify all hazards with the potential to cause fatality to persons offsite. This is done using the analysts' experience, the design engineers engineering knowledge, experience and a systematic review of the proposed plant and operations.

Each functional area of the plant has been reviewed and the hazards documented. Hazards considered to have the potential to impact offsite are evaluated further.

The functional areas evaluated represent the plant in its entirety and are as follows:

- Natural Gas Feed Line;
- Methanol plant;
- Methanol Storage Tanks;
- Methanol export pipeline (Plant - Wharf);
- Methanol Marine Loading Arm; and
- Shipping Channel.

## 5.3 Consequence Analysis

### 5.3.1 Introduction

The objectives of the Consequence Analyses are to demonstrate that:

- toxic and flammable inventories have been identified;
- a representative set of release cases has been chosen for analysis;
- the effects of an unignited release have been evaluated (in terms of hydrocarbon and toxic gas concentrations);
- the effects of an ignited release have been evaluated; and
- the consequences of each release have been identified in terms of the potential for:
  - offsite fatalities;
  - damage to inventory holders, such as vessels and pipework.

The methodology used to achieve these objectives is described below.

### 5.3.2 Inventory Identification

The analysis is based on the identification of all inventories existing on the Methanol Plant, either contained in storage or in 'live' plant. All inventories are quantified in terms of an operating 'basecase' which is a set of basic operating parameters which consist of inter-alia operating pressure and temperature of each plant section, typical inventory compositions, and so on.

Plant inventory volumes are described in terms of the volume contained in isolatable sections separated by designated ESD valves. In some instances an isolatable section consists of one or more process vessels and associated pipework. The inputs for this estimation process are conservative and are based on the proposed process flow diagrams and equipment datasheets.

An extension to this philosophy of inventory identification was used in this study. Due to the variation of process conditions that are not separated by ESD valves, non-return valves were used as isolation points. But this situation by design the inventory could flow downstream to the next isolation section but not upstream to the previous. This was taken into account when determining the inventory for a release from a given section, ie the inventory available includes all that upstream to last ESD valve, but not the material downstream of the next non-return valve.

The Quantitative Risk Assessment, to be conducted at a later stage, will have available more detail and greater accuracy with regards to the process equipment, isolatable sections and inventories and the effect of the control and shutdown system.

To ensure conservatism in the consequence models the available inventory is assumed to pass through the release and not flow to the flare or venting systems described in Section 4.3.3.

### 5.3.3 Release Types and Scenarios

Based on the results of the inventory estimation processes, each inventory may be expected to give rise to one or more release scenarios, which are characterised as follows:

- high pressure gas jet fires;
- flash fires arising from the ignition of a flammable gas cloud;
- explosions arising from the ignition of a confined or semi-confined flammable gas cloud; and
- toxic gas clouds.

The above list is typical of scenarios encountered in the Preliminary Risk Assessment.

There are 259 different events considered in this preliminary risk analysis of the proposed methanol plant. A list of the events and the frequency of each is included in Appendix O.

### 5.3.4 Release Sizes

The size of release affects the following consequences:

- Likelihood of ignition;
- Likelihood of explosion given ignition;
- Magnitude of an explosion;
- Magnitude of a fire;
- Fire duration; and
- Toxic cloud size.

Release frequency information is available for hole sizes ranging from 7 mm to full bore ruptures of large diameter piping. Representative ranges of release sizes have been modelled. Details of each release are provided in Section 6.

In assessing release duration for isolatable sections, consideration is made of the time taken to detect the release and effect ESD.

### 5.3.5 Consequence Modelling

Discharge rate modelling, toxic effects, fire and explosion scenario modelling follows on from the foregoing inventory identification and release size classification schemes.

Consequence analysis of flammable releases is of importance in evaluating the effects of an ignited release in terms of radiation, overpressures, and the consequences of the release on other vessels.

Release dispersion, and subsequent fire, explosion and toxic effects, are performed with the DNV consequence modelling package Phast [10]. Full details of the modelling contained in Phast are available on request.

## 5.4 Frequency Analysis

### 5.4.1 Introduction

The objectives of the Frequency Analysis are to demonstrate that:

- the event development is valid;
- the failure data used are valid; and
- the frequency of each of the hazardous events has been correctly determined.

The achievement of these objectives is described as follows:

- Initiating event frequencies are selected from a review of available data sources. A parts count of the plant is conducted.
- Ignition probabilities for flammable releases are selected from a review of available data and expert judgement published for onshore plant.
- Combining release frequency with ignition probabilities (and applicable mitigation measures) gives rise to a range of gas release, fire and explosion event frequencies.
- Combining release frequency with wind direction and weather state probabilities gives rise to a range of flammable and toxic clouds.

## 5.5 Quantitative Risk Assessment (QRA)

### 5.5.1 Introduction

The objectives of the QRA are to demonstrate that:

- the frequency of each of the Hazardous Events and the associated consequences has been evaluated;
- individual risk and societal risk contours produced;
- the major risk contributors have been identified;
- the sensitivity of the results to key assumptions has been addressed and is understood; and
- the offsite risks have been assessed.

### 5.5.2 Risk Calculation Methodology

The risks are determined for each hazardous event by combining each event frequency with the event outcomes, which are defined in the consequence analysis in terms of structural and human response. These are then cumulated for all events.

The risk arising from these events is calculated using the risk calculation package Riskplot II [18].

Riskplot II calculates Individual Risk Per Annum (IRPA) contours and societal risk taking into account the following:

- Release scenario frequency (including releases initiated by escalation of an adjacent event);
- location of release;
- magnitude of consequence;
- local meteorology; and
- local topography.

The risks are calculated so that for given locations, the risk profile can be identified over and above the average IRPA as given by the risk contour.

In calculation of the risk from toxic events, it is assumed that exposed personnel are "nailed to the spot" for 60 minutes. Considering the turbulent winds of Burrup Peninsula and the distances to the nearest offsite populations, giving ample time to warn these people, then this is a conservative assumption.

For fire events in this Study, the approach is described below and one assumption included is that there will be a response time of 60 seconds. Heat radiation effects as described in the *Hazardous Industry Planning Guidelines for Hazard Analysis* [15] are given in the following Table 5-1.

The resulting assumption of 60 seconds exposure has been deemed reasonable as thermal consequences are short lived and the worst case results are used in the thermal probit to determine fatality and these elements of the scenarios are extremely short lived. Jet fire consequences are worst within the few seconds following ignition, and the drop off as the pressure in the plant drops off. A pool fire has the source, the pool, increasing in size until ignition, but once ignited the burnrates typically exceed the release rates from the leak, thus the worst case consequences are near the initial ignition and are short lived. The thermal effects from a flash fire are short lived, typically over within 20 seconds, thus the 60 second exposure assumption is extremely conservative in these cases. The thermal probit require thermal exposure and duration of exposure, thus the worst case exposure coupled with the assumption of 60 seconds exposure is considered reasonable by QEST risk analysts.

For overpressure events in this Study overpressure effects on humans are used as described in the *Hazardous Industry Planning Advisory Paper No. 4* [14] are given in Table 5-2.

***Table 5-1 Radiation Effect Levels***

| Radiation Level ($kW/m^2$) | Effect |
|---|---|
| 4.7 $kW/m^2$ | Will cause pain in 15-20 seconds and injury after 30 seconds exposure (at least second degree burns will occur) |
| 12.5 $kW/m^2$ | There is a significant chance of fatality for extended exposure and a high chance of injury.<br>Causes the temperature of wood to rise to a point where it can be ignited by a naked flame after long exposure.<br>Thin steel with insulation on the side away from the fire may reach a thermal stress level high enough to cause structural failure. |
| 35 $kW/m^2$ | Cellulosic material will pilot ignite within one minute's exposure.<br>There is a significant chance of fatality for people exposed instantaneously. |

***Table 5-2 Overpressure effect levels***

| Overpressure Level (kPa) | Effect |
|---|---|
| 21 kPa | Reinforced structures distort<br>Storage tanks fail<br>20% chance of a fatality to a person in a building |
| 35 kPa | House uninhabitable<br>Wagons and plants items overturned<br>Threshold of eardrum damage<br>50% chance of fatality for a preson in a building and 15% chance of fatality for a person in the open |
| 70 kPa | Threshold of lung damage<br>100% chance of fatality for a person in a building or in the open<br>Complete demolition of houses |

The human toxic impact figures are determined using the following TNO Green Book probit [4], a source widely respected in industry.

The fatality probability values given for a range of concentrations and a 60 minute exposure time to carbon monoxide is given in Table 5-3.

***Table 5-3 : Toxic Fatality Probability***

| Concentration (ppm) | Exposure Time (mins) | TNO Predicted Fatality Prob (%) |
|---|---|---|
| 100 | 60 | 1% |
| 500 | 60 | 3% |
| 1000 | 60 | 11% |
| 2500 | 60 | 37% |
| 5000 | 60 | 64% |
| 7500 | 60 | 78% |
| 10000 | 60 | 86% |
| 15000 | 60 | 93% |
| 20000 | 60 | 96% |
| 30000 | 60 | 99% |

## 5.6 Assessment of Results

The risk levels as calculated are compared against the DEP acceptance criteria. The DEP acceptance criteria are as follows:

- the offsite risk at the site boundary is less than $5\times10^{-5}$ per year;
- the risk levels from pipeline incidents are less than $5\times10^{-5}$ per year at the utilities corridor boundary; and
- the risk levels from the site are less than $1\times10^{-5}$ per year at Withnell Bay.

## 5.7 Checking, Audit and Review

### 5.7.1 Checking of Input Data

The basis of the PRA is the Facility Process Flow Diagrams. The Facility Process Flow Diagrams provide the 'basecase' data concerning plant layouts, operational conditions and so on, that are input to the PRA risk calculation.

Where necessary, additional input data for the PRA studies consist of information from various sources within GTL, operating companies in the vicinity of the proposed plant and government bodies and authorities.

The responsibility for ensuring that the input data provided by these groups is correctly incorporated into the studies lies with QEST Consulting Engineers. QEST operates a quality control system in accordance with AS/NZS 9001:2000 and all work associated with the Project has been performed under the standard QEST Quality Assurance (QA) System.

### 5.7.2 Review of Assumptions

Numerous assumptions are made as part of the Preliminary Risk Assessment process and it is vital that all assumptions can be traced and verified. Assumptions are commonly made where data are not readily available, or calculations could not be undertaken, or alternatively where it is necessary to define certain operational aspects. All assumptions are recorded in Appendix E.

# 6 RISK ASSESSMENT

## 6.1 Introduction

The objective of the Preliminary Risk Assessment (PRA) of the Methanol Plant is to demonstrate that, as far as is reasonably practicable:

- all credible accident events that have the potential to cause fatalities offsite have been identified;
- the offsite risk at the site boundary is less than $5\times10^{-5}$ per year; and
- the offsite risk at Withnell Bay is less than $1\times10^{-6}$ per year.

To these ends, the methodology outlined in Section 5 has been followed.

## 6.2 Hazard Identification

Risk analysts using the typical Process Flow Diagrams for the plant, and discussing plant details with the plant designers and GTL conducted the Hazard Identification.

The identified hazards considered as having the potential to impact offsite and therefore evaluated in the risk analysis studies are presented in Table 6-1.

***Table 6-1 : Potential Hazardous Events Examined in Risk Analysis***

| Location | Event | Release |
|---|---|---|
| Natural Gas Feed Line | Major leak or rupture. | Methane |
| Unit 100 – Reforming | Major leak or rupture. | Methane, Hydrogen, Carbon Monoxide |
| Unit 200 – Methanol Synthesis | Major leak or rupture. | Methane, Hydrogen, Carbon Monoxide, Methanol (g) |
| Unit 300 – Methanol Distillation | Major leak or rupture. | Methanol (l) |
| Unit 400 – Intermediate Methanol Tank Farm | Major leak or rupture. | Methanol (l) |
| Unit 1100 – Methanol Product Farm & Ship Loading | Major leak or rupture. | Methanol (l) |
| Unit 1170 – Methanol Pipeline Corridor | Major leak or rupture. | Methanol (l) |
| Shipping Channel | • Ship to ship collision.<br>• Grounding.<br>• Collision with fixed structure.<br>• Fire/explosion onboard.<br>• Tank material failure. | Methanol (l) |

## 6.3 Consequence Analysis

### 6.3.1 Inventory Identification

In order to properly characterise and quantify the consequences of a release from the process plant it is necessary to identify the toxic and flammable inventories which may be released.

As the plant is not at design stage, not all inventories can be accurately determined. However, isolatable inventories have been conservatively estimated based on a plant of similar capacity and technology.

Inventory information is shown in Table 6-2. This is used to arrive at estimates of vapour and liquid inventories in component equipment items in each isolatable inventory, and is used as a basecase from which to proceed in consequence analysis. This table also gives an overview of the pressure and temperature in each isolatable section. The use of the lowest temperature and highest pressure for any given section gives the greatest flowrate across a release and thus more conservative consequences.

Detailed piping information for the plant was not available for this analysis from which to derive inventories. Instead, a conservative estimation of the piping inventory was made and a simple factor of 20% was added to the volume of the associated vessels and equipment to approximate the piping volume.

***Table 6-2: Isolatable Section Inventories***

| Isolatable Section | Location | Compounds Modelled | T min (C) | P max (kPa) | V ($m^3$) |
|---|---|---|---|---|---|
| ISO1 | Unit 100 | $CH_4$ | 40 | 2300 | 23 |
| ISO2 | Unit 100 | $CH_4$ | 210 | 4000 | 128 |
| ISO3 | Unit 100 | $CH_4$ | 210 | 4000 | 1 |
| ISO4 | Unit 100 / Unit 200 / Unit 300 | $H_2$, CO | 560 | 30 | 153 |
| ISO5 | Unit 200 | $CH_3OH$, $H_2$ | 40 | 8000 | 138 |
| ISO6 | Unit 200 / Unit 300 | $CH_3OH$ | 40 | 550 | 45 |
| ISO7 | Unit 300 | $CH_3OH$ | 38 | 300 | 199 |
| ISO8 | Unit 300 | $CH_3OH$ | 92 | 860 | 1 |
| ISO9 | Unit 300 / Unit 400 | $CH_3OH$ | 40 | 600 | 2462.8 |
| ISO10 | Unit 400 | $CH_3OH$ | 40 | 300 | 1191 |
| ISO11 | Unit 400 | $CH_3OH$ | 40 | 300 | 1 |
| ISO12 | Unit 400 | $CH_3OH$ | 40 | 300 | 60000 |
| ISO13 | Unit 400 | $CH_3OH$ | 40 | 300 | 4 |
| ISO14 | Unit 300 / Unit 400 | $CH_3OH$ | 25 | 101.3 | 1190 |
| ISO15 | Unit 300 / Unit 400 | $CH_3OH$ | 25 | 101.3 | 4 |
| ISO16 | Unit 1100 | $CH_3OH$ | 25 | 300 | 4 |
| ISO17 | Unit 1100 | $CH_3OH$ | 25 | 101.3 | 25 |
| ISO18 | Unit 1100 | $CH_3OH$ | 25 | 101.3 | 1870 |

The following chemical release events were analysed in the process area:

- A major leak from the natural gas feed line to the Methanol complex;
- A range of representative releases of methane;
- A range of representative releases of hydrogen at various combinations of pressure and temperature;
- A range of representative releases of Methanol at various combinations of pressure and temperature.
- Carbon monoxide releases for the post reforming products.

Further release events analysed were:

- A range of representative releases of Methanol from the Methanol storage;
- A range of representative releases of Methanol from the Methanol export pump;
- A range of representative releases of Methanol from the pipeline to the jetty;
- A range of representative releases of Methanol from the marine loading arm.

### 6.3.2 Release Sizes

The range of release sizes used for this analysis is 7mm, 22mm and 70 mm. This is the range of release sizes deemed appropriate by E & P Forum [7]. Ruptures are considered for certain equipment such as process vessels; as well as, pipework.

In assessing release durations for isolatable sections, consideration is made of the time taken to detect the release and effect ESD.

### 6.3.3 Release Types and Scenarios

#### 6.3.3.1 High Pressure Gas Jet Fires

For the purposes of fire risk analysis, high-pressure jet fires have two distinct sets of consequences. Firstly, personnel are directly affected by the radiation from the flame which can cause death or injury if persons are exposed for a sufficient length of time. If meteorological conditions are not favourable, then combustion products may also pose a threat to escaping persons. Secondly, if the flame impacts on structure, pipework or adjacent inventories, then these may fail and give rise to additional releases, thus exacerbating the initial hazard.

High-pressure releases are particularly hazardous due to the inherent results of burning a relatively large amount of inventory in a short space of time. This is accentuated by the high momentum of the release, which gives rise to rapid entrainment and mixing of air, in turn resulting in efficient combustion and levels of radiation which are severe. On the other hand, because the jet release involves a rapid release of inventory, the fire may be of comparatively short duration. These releases will not therefore lead to knock on releases as the release will burn out before surrounding structures fail.

#### 6.3.3.2 Flash Fires

Flash fires may result from the ignition of a cloud of released material. For example, this may be from a jet of released gas where the momentum has been expended. The flash fire occurs due to the delay in ignition of the initial release which gives an opportunity for the development of a flammable cloud. Now, ignition and combustion of the cloud results in its rapid expansion. If this expansion is impeded then overpressures are produced and the combustion process is modelled as an explosion (see below). For clouds released in open, unenclosed conditions then overpressure effects are minimal and the principal hazard is due to the high levels of radiation produced by the ignition and swift combustion of a large mass of gas. Escalation to structures and inventory is not of principal concern due to the short duration of the flash fire. However, if the release is still ongoing, then the flash fire will be followed by a jet or pool fire where escalation issues regain importance.

#### 6.3.3.3 Explosions

A flammable release may give rise to an explosion if the resulting flammable cloud forms in an area which is semi-confined, for example a piperack, or where there is a degree of congested pipework. In these circumstances, if ignition were to occur then turbulence resulting from the movement of burning gases may result in flame acceleration to a point where combustion products may not be able to vent efficiently, resulting in an overpressure with the capability of damaging buildings or structure. In these circumstances the hazards to personnel are three-fold. Firstly, exposing personnel to overpressure directly or indirectly has the potential to cause injury or fatality. Secondly, the overpressure may result in damage to adjacent vessels and pipework, causing additional flammable releases. Lastly and most importantly overpressure may result in damage to adjacent vessels and pipework, causing additional toxic releases.

#### 6.3.3.4 Toxic Releases

A release of carbon monoxide will result in the development of a toxic cloud. As carbon monoxide has a slightly lower density then air it will readily diffuse into air and reach safe concentrations. However, there can be fatal consequences for people enveloped in a cloud with carbon monoxide concentrations of greater than 1000 ppm.

## 6.4 Consequence Modelling

This section describes the methods by which flammable releases are characterised and the consequences analysed. The analysis of the frequencies with which these releases occur is described in Section 6.5.

All consequence modelling has been performed using the computer consequence analysis package Phast Version 6.0 [10]. Phast is able to model all the events listed above by considering parameters relating to the following:

- release geometry;
- material properties; and
- meteorology.

### 6.4.1 Modelling Assumptions

In order to model the behaviour of ignited and unignited releases from the inventories described in Table 6-2, it is necessary to establish basic parameters for the climatic conditions for the models to run.

#### 6.4.1.1 Methanol Plant Site

The Site was assumed to have the following properties, which are input to Phast:

- The mean day time temperature is taken to be 302K (29°C);
- Ground temperature for day time is assumed to be 302K (29°C);
- The mean night time temperature is taken to be 288K (15°C);
- Ground temperature for night time is assumed to be 288K (15°C);
- Mean annual humidity is assumed to be 43%; and
- Roughness length for dispersion calculations is assumed to be 0.03m (corresponding to "flat land with few trees").

#### 6.4.1.2 Leaks and Emissions

For leaks and emissions, the following basic assumptions apply to the modelling process:

- all leaks are assumed to originate 1.0 m above ground level;
- all jet leaks are assumed to be horizontal;
- leaks are assumed to be through a sharp-edged orifice with a leak path of negligible length;
- where 'rupture' leaks are modelled as initiating events, these are analysed as continuous leaks where the leak diameter is that of the largest connection attached to the vessel; and
- spills are assumed to take place on the Phast option of "concrete".

#### 6.4.1.3 Fires and Explosions

For fires and explosions, the following basic assumptions apply to the modelling process:

- Jet and pool fires are modelled using steady-state conditions using Phast; and
- It is assumed that initial release rates can be used to define effect distances for dispersing gas clouds and jet fires.

### 6.4.2 Phast Modelled Criteria

The results from the consequence analysis are presented and discussed in the following sections.

In order to use the Phast package to model a leak and ignition scenario it is necessary to define impact criteria for the consequences against which the models can be evaluated.

The criteria used for the consequence analysis are those described below:

**Thermal Radiation**

As discussed in Section 5.5.2, the human impact of heat radiation is determined using the method discussed in the TNO Green Book [8].

Structural damage is considered where a structure is impacted by thermal radiation of 50 kW/m2 for greater than 15-20 minutes. However all vessels on this plant would be depressurised within that time.

An example of thermal radiation consequences are presented in Table 6-3.

***Table 6-3 : Thermal Consequence Distances for a Methane Gas Release***

| Flux ($kW/m^2$) | Fatality Probability (%) | Downwind Distance (m) | | |
|---|---|---|---|---|
| | | 70 | 22 | 7mm |
| 4 | 10 | 157 | 51 | 17 |
| 12.5 | 50 | 145 | 47 | 16 |
| 37.5 | 100 | 141 | 46 | 15 |

**Explosions**

The criteria input to Phast for the calculation of overpressures (explosions) from a release in the plant, derived from TNO [8], are summarised in Table 6-4.

***Table 6-4 : Overpressure Consequence Distances for Explosions***

| Probability of Fatality (%) | | |
|---|---|---|
| Inside | Outside | Overpressure (kPa) |
| 20 | 0 | 21 |
| 50 | 15 | 35 |
| 100 | 100 | 70 |

An example of the consequences of an overpressure due to a methane release from the feed and desulphurisation section is presented in Table 6-5. All consequence modelling results are available on request.

***Table 6-5 : Overpressure Consequence Distances for a Methane Release***

| Overpressure (kPa) | Radial Distance (m) |
|---|---|
| 21 | 60 |
| 35 | 57 |
| 70 | 55 |

**Toxic Consequences**

An example of the toxic consequences due to a carbon monoxide release from the post-reformer section of the plant is presented in Table 6-6. All consequence modelling results are available on request.

***Table 6-6 : Toxic Consequence Distances for 22mm Release***

| Concentration (ppm) | Fatality Prob (%) | Downwind Distances (m) |
|---|---|---|
| 1000 | 10 | 155 |
| 3500 | 50 | 135 |
| 35000 | 100 | 56 |

### 6.4.3 Natural Gas Feed Line

A 219mm (OD) feed Steel Grade pipeline operating at approximately 6 MPag with a flow rate of 72TJ/day has been assumed in this assessment. The pipeline will run directly from the Woodside Onshore Treatment Plant located less then 1000m from the west boundary of the site. The battery limit is located in the north west corner of the site. There will be no intermediate facilities however there will be a meter/regulator station at the battery limit of the plant site.

#### 6.4.3.1 Release Events

Releases resulting from pipeline failure due to material of construction or maintenance faults, or external impacts would range from pinhole to full pipe ruptures. The jet flame extends for approximately 212 m for a full pipe rupture. This has the potential to impinge on the western half of the plant site. Unit 200, Methanol Synthesis, is within this 212 m radius. This could result in the domino effect of causing further fires and/or explosions in this unit.

The thermal effects resulting from jet fires for a range of hole sizes are included in Table 6-7.

***Table 6-7 : Thermal Effects for Methane Fires from the Feed Pipeline***

| Heat Flux ($kW/m^2$) | Fatality Prob (%) | Downwind Distances (m) | | | |
|---|---|---|---|---|---|
| | | Rupture | 70 mm hole | 22 mm hole | 7 mm hole |
| 37.5 | 100 | 250 | 103 | 33 | 11.5 |
| 12.5 | 50 | 285 | 117 | 37.5 | 13 |
| 4 | 10 | 345 | 140 | 45 | 15.5 |

#### 6.4.3.2 Basis for Modelling

A jet fire, which could result from a rupture of 6 MPag natural gas, is likely to travel in the direction of the gas flow through the pipe. The battery limit is located in the north west corner of the plant, in the event of an ignited rupture the jet will be in the direction of the plant (as the gas flow is to the east towards Unit 100), thus not placing offsite locations at risk.

### 6.4.4 Methanol Process Plants

#### 6.4.4.1 Release Events
Isolatable sections 1 through 16 from Table 6.2 describe the events that are modelled for the on-site releases.

#### 6.4.4.2 Basis for Modelling
All vessels and associated equipment within the methanol production units within the plant are able to be remotely isolated. The vast majority of releases will occur in small inventory items such as small heat exchangers, pipes etc. 90% of large releases (≥70 mm) are assumed to cease in less than 60 seconds.

### 6.4.5 Methanol Storage

#### 6.4.5.1 Release Events
The Methanol Storage tanks have a capacity of 60,000 $m^3$ each, thus providing for potentially large scale consequences if a leak were to occur. The releases modelled are sustained releases from pinhole leaks through to rupture.

#### 6.4.5.2 Basis for Modelling
It is conservatively assumed in this study that the wall of the tank is breached and the full contents are released.

### 6.4.6 Export Pump

#### 6.4.6.1 Release Events
A release from seals or valve rupture. The pump is assumed to be isolated within 60 seconds.

#### 6.4.6.2 Basis for Modelling
The pump will stop automatically on activation of the Emergency Shutdown (ESD) system.

### 6.4.7 Pipeline from Plant to Wharf
The export pipeline that is proposed to run from the plant to wharf is a 24” diameter liquid line, with a length of approximately 6.5 km.

#### 6.4.7.1 Release Events
The following release events are being considered for the plant to wharf pipeline:
- Pipeline failure due to material of construction or maintenance faults or external impacts.
- Leakage from the isolation valve at the wharf.

#### 6.4.7.2 Basis for Modelling
The liquid line was assumed to have the following safety controls:
- Valves to be welded to pipework;
- Isolation valves at end of each pipeline which will automatically close on operation of ESD system; and

- Pressure monitoring of pipeline during operation for automatic monitoring of pipeline and activating ESD valves on sudden pressure drop.

The export line is considered to have two sets of conditions, one during exporting when the export pumps are applying pressure and the other during non-loading times when the pipe pressure is considered to be slightly above atmospheric pressure. Loading is to take place approximately every 10 days and will last approximately 20 hours. The pipe is considered to be loading 10% of the time, while during the remaining 90% of the time the pipe is left idle but the methanol is left within the pipe, thus the near atmospheric pressure during this period.

### 6.4.8 Marine Loading Arm

#### 6.4.8.1 Release Events

A release from any of the valves or pipework in the Loading Arm.

The pressure and temperature in the Loading Arm will approach ambient, that is the atmospheric pressure and the surrounding temperature. This provides minimal driving force for the flow of methanol from a release. If a release occurs the low flowrate results in localised poolfires if the release is ignited. The poolfires modelled resulting from a loading arm release have 10% fatality probability levels within 40m of the release point.

#### 6.4.8.2 Basis for Modelling

If a no-flow signal is received from flow switches installed on the discharge flow meter, the ESD system will be activated. In addition, isolation valves at each end of the liquid line will automatically close on operation of ESD system.

All other activity on the wharf ceases throughout tanker loading operations. Procedures to warn against and prevent non-approved activities during loading will be implemented.

An operator will be stationed at the wharf throughout the entire loading operation.

### 6.4.9 Shipping Hazards

The new Dampier Wharf will have a dedicated shipping channel. It will be dredged to accommodate up to 12m draft (generally 50-60,000 DWT) vessels. The new channel will head north west from the new wharf for 3.3 nautical miles.

There are 2 other channels in the harbour. One from the Hamersley Iron, Parker Point Jetty and one from the Woodside Offshore LNG and LPG Petroleum Jetties. However these will not be connected to the new channel.

Two vessels cannot be in the same channel at the same time. Vessels must wait outside the harbour unless a clear passage is available. All non local vessels require a local pilot. This would include the methanol tankers.

Dampier Port Authority monitors vessel movements and ensures that major vessels in the same area of port are in communication with each other.

## 6.5 Frequency Analysis

### 6.5.1 Introduction

With respect to the release events under consideration, these are defined according to the taxonomies of hole size (7mm, 22, 70 and rupture), and the release inventories set out in Table 6.2 where the lists of isolatable sections for the Methanol Plant are given.

Based on the process sectionalisation, the frequency of hydrocarbon releases associated with each section and each area has been determined. The leak frequency has been estimated on a "parts count" approach using generic component failure frequencies. The number of equipment items in each process section is estimated. Using generic failure frequencies, the leak frequency for the section is taken as the sum of frequencies of the individual components.

Overall leak frequencies are presented in Section 6.5.2.

### 6.5.2 Methodology for Estimation of Initiating Event frequency

In order that a facility-specific estimation of all fire and explosion initiating events (and corresponding release frequencies) be included in the frequency estimation, a traditional parts count approach has been used utilising P&IDs for a Methanol Plant of similar design. This involves counting and listing all pieces of equipment and associated fittings within the isolatable sections defined in Section 6.3.

All details are entered onto proforma sheets for each separate section, included in Appendix I, which incorporate the selected leak frequencies for each individual hole size in the distribution are as described in Section 6.3.2. The release frequencies derived from the parts counts from the generic leak frequencies in Table 6-8 are then determined. These final release frequencies are presented in Table 6-9. A sensitivity analysis of this study incorporating rupture of pipework was performed, the details of which are in Appenidx L.

***Table 6-8 : Generic Failure Frequencies Used In This Study***

| | HOLE SIZE FREQUENCIES | | | | |
|---|---|---|---|---|---|
| | Small | Medium | Large | Rupture | Total |
| EQUIPMENT ITEM | 7 | 22 | 70 | | |
| Tank | 0.00E+00 | 0.00E+00 | 1.00E-06 | 6.00E-06 | 1.00E-06 |
| Pump | 2.49E-02 | 1.27E-03 | 1.11E-04 | | 2.63E-02 |
| Reciprocating Compressor | 6.24E-01 | 3.17E-02 | 3.96E-03 | | 6.60E-01 |
| Centrifugal Compressor | 1.65E-02 | 8.42E-04 | 1.03E-04 | | 1.74E-02 |
| Pressure Vessel | 3.78E-05 | 3.78E-05 | 8.40E-06 | 1.31E-06 | 8.40E-05 |
| Small Pipe <150mm | 1.14E-05 | 2.82E-06 | 1.31E-06 | | 1.55E-05 |
| Large Pipe >=150mm | 1.14E-05 | 2.82E-06 | 1.31E-06 | | 1.55E-05 |
| Heat Exchanger (S&T) | 7.82E-03 | 9.67E-04 | 0.00E+00 | | 8.79E-03 |
| Flange | 1.03E-02 | 1.50E-03 | 7.50E-04 | | 1.25E-02 |
| Valve | 3.96E-04 | 9.79E-05 | 3.26E-05 | | 5.27E-04 |

*Table 6-9 : Total Release Frequencies*

| Leak Point | 7 mm release | 22 mm release | 70 mm release | Rupture | TOTAL |
|---|---|---|---|---|---|
| ISO1 | 7.64E-01 | 7.46E-02 | 2.04E-02 | 1.31E-06 | 8.59E-01 |
| ISO2 | 6.71E-02 | 1.54E-02 | 6.13E-03 | 5.24E-06 | 8.87E-02 |
| ISO3 | 7.89E-03 | 2.87E-03 | 1.19E-03 | 0.00E+00 | 1.20E-02 |
| ISO4 | 1.96E-01 | 4.55E-02 | 1.21E-02 | 5.24E-06 | 2.54E-01 |
| ISO5 | 1.21E-01 | 2.21E-02 | 6.11E-03 | 2.62E-06 | 1.50E-01 |
| ISO6 | 1.33E-02 | 4.37E-03 | 2.06E-03 | 1.31E-06 | 1.97E-02 |
| ISO7 | 3.25E-02 | 3.33E-03 | 1.22E-03 | 1.31E-06 | 3.71E-02 |
| ISO8 | 3.80E-03 | 1.24E-03 | 5.95E-04 | 0.00E+00 | 5.64E-03 |
| ISO9 | 2.62E-01 | 4.95E-02 | 1.34E-02 | 1.12E-05 | 3.25E-01 |
| ISO10 | 3.07E-02 | 3.01E-03 | 8.76E-04 | 6.00E-06 | 3.46E-02 |
| ISO11 | 3.41E-02 | 1.16E-02 | 5.01E-03 | 0.00E+00 | 5.08E-02 |
| ISO12 | 3.70E-02 | 5.34E-03 | 1.89E-03 | 6.00E-06 | 4.43E-02 |
| ISO13 | 2.08E-02 | 6.98E-03 | 2.86E-03 | 0.00E+00 | 3.07E-02 |
| ISO14 | 3.01E-02 | 2.87E-03 | 7.67E-04 | 6.00E-06 | 3.38E-02 |
| ISO15 | 3.11E-03 | 7.66E-04 | 4.40E-04 | 0.00E+00 | 4.31E-03 |
| ISO16 | 5.31E-03 | 1.31E-03 | 8.02E-04 | 0.00E+00 | 7.42E-03 |
| ISO17 | 5.40E-02 | 3.56E-03 | 8.11E-04 | 6.00E-06 | 5.83E-02 |
| ISO18 | 6.01E-02 | 5.50E-03 | 2.74E-03 | 3.80E-04 | 6.87E-02 |

### 6.5.3 Event Tree Analysis

All leaks can be modelled using simple event trees to estimate the likelihood that a leak will develop into particular outcomes such as:

- Jet Fire;
- Explosion;
- Flash fire;
- Unignited toxic plume; and
- Liquid Pool.

#### 6.5.3.1 Fire/Explosion/Toxic Release Events

In relation to event trees, leaks are firstly identified as either flammable or toxic. Automatic or manual shutdown is considered followed by the probability of blowdown (venting) occurring.

If the release is flammable, then the probability of ignition is considered. If ignition occurs, this may result in a vapour cloud explosion. A vapour cloud explosion then has the potential to escalate to adjacent areas on the site.

If the release is toxic, there are no escalation effects.

In order to derive the outcome frequencies from the initiating event frequencies, it is necessary to estimate ignition probabilities for each. This is described in Section 6.5.4.

All event trees will be provided on request.

For large leaks in particular, the magnitude of the release is dependent on the success of the ESD system closing the valves for each isolatable section, ie. if this fails open then the inventory of the section will be available for release.

Experience shows that in typical situations involving valves operated by ESD systems that the overall reliability of the system is dominated by the reliability of the valve itself, ie. whether the valve operates, and whether it blocks flow successfully.

Whilst in general the assumption is that all valves operated automatically will function according to the design intent, consideration is taken into account here that in the event the ESD fails open, personnel observing a release will have access to manual intervention (shutdown) from the control room.

#### 6.5.4 Estimation of Ignition Probability

For leaks of flammable gas and liquid, it is assumed that the ignition model presented by Cox, Lees and Ang [12] can be used as a basis to estimate ignition probabilities for use in event tree analysis.

The ignition model of [12] is based on fire and explosion data and 'best-estimates' for both onshore and offshore installations. During the formulation of the model, ignitions were defined as being due to inter alia the following:

- welding/cutting/grinding ie. hot work (where the hot work is also the source of the leak);
- engines and exhausts;
- sparks;
- electrical (including static);
- hot surfaces;
- self-ignition;
- cigarette-lighter, match;
- hot particles;
- friction.

It should be noted that all ignited releases are assumed to occur in areas where sources of ignition should be subject to control, ie. classified hazardous areas. It is concluded that this situation is typical of GTL Methanol Plant conditions, and so the use of the model is justified.

The model predicts the probability of ignition $P_I$ for a flammable release as a function of mass flow R as follows:

Gas Releases (0.5 - 100 kg/s)

$$\log10P_I = 0.6403(\log10R + 1) - 2.444$$

Liquid Releases (0.5 - 100kg/s)

$$\log10P_I = 0.3929(\log10R + 1) - 2.376$$

For the GTL Methanol Plant analysis, the model is applied as discussed below.

It is assumed that $P_I$ is composed of the probability of immediate ignition Pi and the probability of delayed ignition Pd, where:

$$P_I = Pi + Pd$$

Further, it is assumed that delayed ignition can typically either result in a flash fire or an explosion. For any release, the relative likelihood of an explosion compared to flashfire is largely dependent on the level of confinement experienced by the release when ignited. Incident data from Lees [9] indicate that the ratio of flashfires to explosions is 60:40; this is construed here as saying that the likelihood of a flashfire is about the same as for an explosion, given a typical dataset.

Elsewhere, [12] conclude that the probability of explosion given ignition $P_E$ varies between 0.025 and 0.25 depending on mass flow, based on explosion incident data and best estimates from both offshore and onshore applications.

From these two sources, it is therefore assumed that the overall probability of delayed ignition given ignition $P_D$ varies from 0.05 to 0.5 depending on mass flow, ie. double the probabilities derived by [12]. This gives the following correlation:

$$\log10P_D = 0.4346(\log10R + 1) - 1.6048$$

where $P_D$ = $P_E + P_F$, the sum of the probabilities of explosion and flashfire respectively, given ignition.

With respect to the estimation of the probability of explosion given ignition, it seems likely that, for a given release at the Methanol Plant, the probability of explosion given ignition is lower than average. This is concluded from considerations of the Methanol Plant layout which offer less chance of confinement in the event of a significant gas release, with correspondingly less chance of a gas cloud exploding.

Use of the [12} explosion probability correlation is not appropriate in this case, as this includes data from offshore applications where confined explosions are a higher possibility.

As a suitable alternative Kletz [12] has suggested that for onshore plants, $P_E$ is of the order of 0.1 for releases greater than 10 tonnes, and a maximum of 0.01 for releases of 1 tonne or less.

These values are used in this Study as upper bound limits as the Methanol Plant flammable inventories are of this order of magnitude.

The consequence in this case is less than the toxic dispersion.

For all other releases, $P_E$ = 0.01 is used as an upper bound limit to a revised explosion probability correlation for the Methanol Plant. The correlation follows the form:

$$\log10PE = y (\log10R + 1) + x$$

where y and x are coefficients determined from the values of $P_E$ at defined upper and lower limits.

Now, the ignition correlations listed above are calibrated against upper and lower bounds of 0.5 kg/s and 100 kg/s. If the upper bound limit of 100 kg/s is considered in terms of ignition delay time, the amount released in 20 seconds is 20 $\times$ 100 kg = 2 tonnes. The value of 20 seconds is typical of the time require for a release of gas to find an ignition source. This is felt to be sufficiently close to the Kletz limit of 1 tonne to enable the explosion probability of 0.01 to be used as an upper bound to an equivalent explosion probability correlation for Methanol Plant explosions.

For the lower bound mass flow limit, the observation is made that, typically, correlations of this format span two orders of magnitude, ie. here the 0.5 kg/s release may be considered to correspond to an explosion probability of 0.0001. Although in this study all flow rates were much greater then this, thus the frequency of 0.01 was used for all.

It should be emphasised that it is considered that the value of this low limit is not particularly critical so long as it is a suitably small number. Explosions are much less likely than flash fires for small releases in open areas. So, if the explosion probability is under-estimated at small release rates, this will only result in a corresponding over-estimate of the probability of flash fire, given that it is considered that the overall probability of delayed ignition is about right. The consequences of flash fires and explosions in open spaces are similar, giving another reason why the under or over estimation of explosion is acceptable as long as the overall delayed ignition probability is about right. If these limits are adopted, then the refined explosion probability correlation becomes:

$$\log10P_E = 0.8692(\log10R + 1) - 4.61$$

This is used in the analysis, such that above 100 kg/s $P_E$ = 0.01, whilst for massive, ie. vessel rupture release cases, the use of $P_E$ = 0.1 is retained.

### 6.5.5 Shipping Incident Frequency

A collision between the Methanol vessel, and other vessels on arrival, does not have any significant consequences, as there is very little methanol on board. This includes collisions with the jetty on arrival.

Collisions with the jetty on departure have no significant consequences, as the vessel would not be moving with sufficient speed to cause serious damage.

As the port is well monitored and controlled by the Dampier Port Authority, all the vessels will be under the control of a local pilot. The only reasonable scenario in which vessels could come in contact with each other would be due to engine or steering failure. Should any of the larger vessels lose steering or power they would be more likely to run aground prior to colliding with the methanol vessel since their draft precludes moving out of their channel.

The only scenario to be considered, in which the methanol tankers could collide with other vessels is if the steering or engines on a methanol tanker fails. The steering has redundancy and is therefore unlikely to fail. If it did fail it would most likely fail during manoeuvring when arriving at or departing the jetty. Steering failure will not therefore be considered further.

If the methanol tanker engines failed it could drift on a collision course with any of the vessels in the area although smaller vessels should be able to avoid the drifting tanker. If any of the smaller vessels' engines fail they could move out of their channel. However in most cases either tanker would have sufficient time and manoeuvrability to avoid each other. Also any small vessel that have lost their engines would be able to manoeuvre until they slowed sufficiently to be able to drop anchor, preventing collision with other vessels. It is assumed these vessels fail to anchor to 1% of the time.

***Assumptions***

| | |
|---|---|
| The number of methanol exports per year is: | 36 |
| The average vessel payload is: | 30,000 tonne |
| The average length is: | 220 m |

The vessel arrives empty at the public jetty.
The departing vessels are in the harbour for 1 hour.

$P_{\text{engine failure}}$ = 0.25 pa [13]
$P_{\text{doesn't anchor}}$ = 0.01

Given that the current proposed new wharf is to handle four main exporters, it is assumed that there will be approximately 280 vessels using the new channel each year [24]. It is assumed they will be in the harbour for a maximum period of 1 hour for arrival and departure. These vessels may be used for the export of ammonia, urea or DiMethylEther. There are 36 methanol vessels in the harbour for a maximum of 1 hour. Only departures are of concern.

Therefore the frequency of a methanol vessel exiting the harbour while a large vessel is travelling through the harbour is:

$F_{\text{methanol vessel in harbour}}$ = 26 pa
$P_{\text{l vessel in harbour}}$ = 280 / 8760 = 0.032
$f_{\text{l vessel nearby}}$ = $36 \times 0.032$ = 1.15 pa.

Given the probability that the engine fails is 0.25 pa [13], the following scenarios were considered.

The probability that the methanol tanker engine fails during the 36 hours per year it is exiting the harbour is:

$$P_{\text{engine failure 1}} = 36 \times 0.25 / 8760 = 1.0\times10^{-3}$$

The probability that the other vessels' engine fails during the 280 hours per year it is exiting the harbour is:

$$P_{\text{engine failure 2}} = 280 \times 0.25 / 8760 = 8.0\times10^{-3}$$

Therefore, total probability of engine failure is:

$$P_{\text{total engine failure}} = 1.0\text{x}10^{-3} + 8.0\text{x}10^{-3} = 9.0\times10^{-3}$$

This probability is brought forward to assist in determining the risk of methanol release due to ship collision.

If the steering fails, the vessel will most likely travel in the direction it was previously heading prior to the steering failure. It is assumed that the same is the case for a drifting vessel.

If the out of control methanol tanker drifts towards the other vessel the probability of striking a nearby vessel is the ratio of the combined length of the two vessels and the perimeter of a circle radius equal to the distance between them.

The vessel separation while in the harbour varies between 1 and 5 N miles. We will conservatively assume 2N miles is the average separation (ie. 3.7km).

The average length of a large vessel is assumed to be 270 m. The average length of an methanol vessel is assumed to be 220m, therefore their combined length is 490m.

The perimeter length of a circle of radius 3.7km $= 2\pi r$
$= 23250m$

Therefore

$P_{collision} = 490 / 23250$
$= 0.02$

It is assumed that 20% of the collisions are severe enough to penetrate one of the tanks resulting in a significant release of methanol.

Therefore the risk of methanol release due to ship collision is:

$f_{methanol\ release} = f_{lvessel\ nearby} \times P_{total\ engine\ failure} \times P_{doesn't\ anchor} \times P_{collision} \times P_{methanol\ release}$
$= 2.1 \times 2.1\times10^{-2} \times 0.01 \times 0.02 \times 0.2$
$= 1.8\times10^{-6}$

This release frequency is very low, coupled with the fact that ignition is unlikely due to the high miscibility of methanol in water the IRPA will be less considerably less than $10^{-6}$ hence this event will not be considered further.

All methanol tankers would be under radar surveillance from the Dampier Port Authority.

**Hazardous Events**

A further event that may lead to tank rupture whilst a vessel is underway to and from the loading berth is a fire or explosion onboard.

Based on the data presented by Brennan and Peachey, it is stated that 18 fire/explosion events occurred over 19690 ship-years, which equates to $9.1\text{x}10^{-4}$ fire/explosion events per year per ship. The vessel is in the harbour only $36 \times 24$ hours per year, therefore the annual fire/explosion frequency is $9.0\times10^{-5}$. This value incorporates all fire and explosion events and not just the frequency for which the methanol cargo would be ignited as this would be a fraction of this value. This is conservative due to the number of safety systems onboard the vessel which would have to fail to work.

Thermal effects from a fire would be limited to the vessel and immediate surroundings. If the methanol cargo was to ignite it would burn itself out. If the vessel was to rupture, the methanol would rapidly diffuse into the water.

Considering the release frequency is very low, and the consequences very unlikely to impinge onto the wharf, this event is not carried forward.

### 6.5.6 Impacts from Internal Events

There is a risk of some events within the plant area providing knock-on effects from hazardous operations. These are included in the table below.

*Table 6-10 : Internal Knock-on Effects*

| Internal Event | Comment |
|---|---|
| Natural gas feed line release | Releases due to pipeline failure because of material of construction or maintenance faults or external impacts. The ignited jet flame extends for approximately 212m for a full pipe rupture. Unit 200 Methanol Synthesis is within this 212m radius. The impingement on the Methanol Synthesis unit may result in fires and/or explosions in this unit. |
| Methanol Plant – Flammable (methane, hydrogen or methonal) release | Risks from knock on effects from fires and explosions are minimal, as the frequency for these events is relatively low. The knock on release would have minimal impact as the process would be isolated and blown down / vented away from the process area before vessels would fail. |
| Methanol Storage | The risk is minimal as the large-scale poolfires which could result from the methanol storage tanks would require a substantial external impact to initiate. |
| Export Pump | The likelihood of an event impacting beyond the boundary is very low due to the number of protection devices that would ensure any release was of short duration. |
| Pipeline from Plant to the Wharf | Risk is very low due to the low frequency at which fully welded pipelines leak. |
| Marine Loading Arm | Risk is very low due to the low frequency of the event (and minor consequences) due to the many protection devices that would have to fail for an ongoing release. Protection includes:<br>• ESD system automatically activated on no-flow signal.<br>• All other activity on the wharf ceases throughout tanker loading operations.<br>• An operator to be stationed at the wharf throughout the entire loading operation. |
| Shipping Hazards Collision, Grounding, Or Onboard Incident | Risk is very low due to the very low frequency of the event. |

### 6.5.7 Impacts from External Events

The possible impact and knock on effects from other existing or potential hazardous operations in the surrounding area are given in the table below.

*Table 6-11 : External Knock-on Effects on the Plant*

| External Event | Comment |
|---|---|
| LNG Plant and export jetties | The $1 \times 10^{-6}$ contour for the Woodside LNG plant does not impinge on the GTL Methanol plant, thus a knock-on effect from these facilities is very unlikely. |
| Plenty River Ammonia Urea Plant | This plant is located approximately 3.3 km to the SSE and hence will be unaffected by any incidents. |
| Burrup Fertilisers Site | This plant is located approximately 3 km to the SSE and hence will be unaffected by any incidents. |

## 6.6 Quantitative Risk Assessment (QRA)

### 6.6.1 Introduction

The objectives of the QRA are to demonstrate that:

- the frequency of each of the Hazardous Events and the associated consequences has been evaluated;
- individual risk and societal risk contours produced;
- the major risk contributors have been identified;
- the sensitivity of the results to key assumptions has been addressed and is understood; and
- the offsite risks have been assessed.

### 6.6.2 Risk Calculation Methodology

Risk Summation was completed using the Riskplot II calculation software package.

### 6.6.3 Riskplot II analysis of events

#### 6.6.3.1 Summary of Consequence and Frequency Analysis

The risks are determined for each hazardous event by combining each event frequency with the event outcomes. The risk arising from these events is calculated using the risk calculation package Riskplot II. These are then summed for all events.

Riskplot II calculates Individual Risk per Annum (IRPA) and the contours are plotted according to:

- release scenario frequency (including releases initiated by escalation from an adjacent event);
- location of release;
- magnitude of consequence;
- local meteorology;
- local topography.

#### 6.6.3.2 Inputs to Riskplot II analysis

**Weather Frequency Table**

Riskplot II allows a wind rose of speeds and directions to be used to calculate the likelihood that the releases will be blown in a given direction.

**Data Sources**

The wind data used was provided by GTL [17]. It was analysed by Qest and the wind (speed, direction and stability) data was summarised for use in the consequence and risk modelling.

**Processing the Data**

In summarising the data, it was necessary to make a series of assumptions. These were based on Table 3.2 which shows the processed wind/weather probability data for the site used in the risk calculations.

The states modelled are 2.5B, 4.2C, 6.3C, 1.8F, 3.0F and 5.1D, where the value represents speed in m/s and the letter is the stability coefficient.

The remaining meteorological conditions required are described in Section 3.1.3.

**Population Distribution**
In Riskplot II, the population at risk is defined in terms of location and numbers of persons.

In order to use Riskplot II, it is necessary to lay out a grid over the site plan in order to define the locations of the population of interest.

For the GTL Methanol Plant, the locations of populations was based on the National Grid. The nominated population groups are therefore located as listed in Table 6-12, where the coordinates are in metres.

***Table 6-12 : Riskplot II Population Locations***

| Company | Population[1] | Northerly Coordinates | Easterly Coordinates |
|---|---|---|---|
| Woodside Onshore Treatment Plant (LNG) plant | 100 | 7720700<br>7721500<br>7720550<br>7719750 | 474250<br>474650<br>476350<br>475800 |
| Plenty River Ammonia Plant | 40 | 7718600<br>7718600<br>7719500<br>7719600 | 476700<br>475950<br>476150<br>476700 |
| Burrup Fertiliser Plant | 40 | 7719667<br>7719583<br>7718542<br>7718583 | 476458<br>477167<br>477250<br>476583 |

[1] daytime population only [20,21]

**Location of Plant Facilities**
In Riskplot II, the GTL Methanol Plant isolatable sections referred to are defined in terms of location based on the National Grid as listed in Table 6-13 below, where the coordinates are in metres.

*Table 6-13 : Riskplot II Facility Locations*

| Area | | Northerly Coordinates | Easterly Coordinates |
|---|---|---|---|
| ISO1 | Unit 100 | 7722861 | 478056 |
| ISO2 | Unit 100 | 7722845 | 478085 |
| ISO3 | Unit 100 | 7722854 | 478074 |
| ISO4 | Unit 100 / Unit 200 / Unit 300 | 7722867 | 478088 |
| ISO5 | Unit 200 | 7722813 | 478012 |
| ISO6 | Unit 200 / Unit 300 | 7722835 | 478042 |
| ISO7 | Unit 300 | 7722785 | 478077 |
| ISO8 | Unit 300 | 7722786 | 478086 |
| ISO9 | Unit 300 / Unit 400 | 7722790 | 478110 |
| ISO10 | Unit 400 | 7722836 | 478135 |
| ISO11 | Unit 400 | 7722838 | 478155 |
| ISO12 | Unit 400 | 7722819 | 478200 |
| ISO13 | Unit 400 | 7722844 | 478225 |
| ISO14 | Unit 300 / Unit 400 | 7722764 | 478234 |
| ISO15 | Unit 300 / Unit 400 | 7722796 | 478204 |
| ISO16 | Unit 1100 | 7722856 | 478132 |
| ISO17 | Unit 1100 | 7722829 | 478143 |
| ISO18 | Unit 1100 | 7720400 | 473700 |

**Riskplot II Analysis Outputs**
The input described in Section 6.6.3.2 is used in the Riskplot II package to calculate risk under two headings:

- individual risk; and
- societal risk.

The application of this calculation to the Methanol Plant analysis is described below.

**Calculation of Individual Risk**
Section 6.6.3.2 describes how flammable inventories are located on the Methanol Plant site plans for the purposes of Riskplot II according to a system of Cartesian coordinates.

For individual risk, Riskplot II combines the effect distances for each event which correspond to specified fatality criteria and sums these for the site of interest. For each coordinate, the risk is summed according to the number of events whose effect distances overlap, the corresponding fatality criterion for each effect distance, and the estimated frequency of the event.

Contour lines are therefore produced which link to the cells on the grid where the risk is the same, ie. 'iso-risk' contours. In Riskplot II, contours can be generated for the entire site area, or for localised areas.

For the GTL Methanol Plant, risk contours are generated according to offsite fatality criteria. Inter alia, these are intended to show the distance around the plant to the risk level of $5x10^{-5}$ fatalities per year.

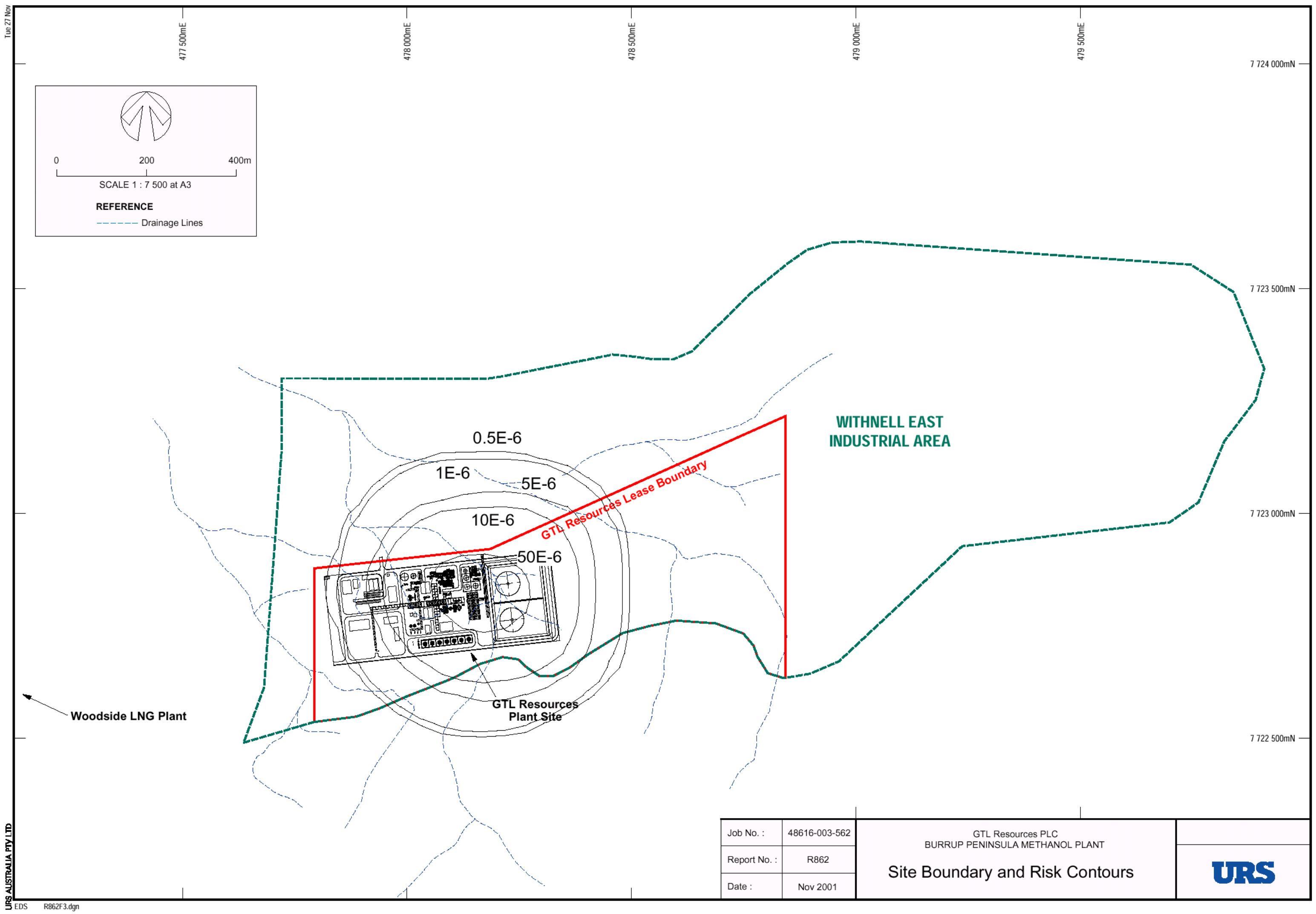
The quantified risk at these locations represents the level experienced by a person present for 24 hours a day.

The individual risks calculated for the Methanol Plant are presented in the form of risk contours on a map of the area in Figure 6-1.

The risks determined for the pipeline are wharf are below 0.5E-6. The pipeline was modelled for the continuous use it will experience, 10% of the time methanol being pumped through it for export and the remaining time methanol is in the pipe at ambient conditions. The wharf was only modelled for the 10% of time it would be in use.

Non-annualised risk for the wharf, ie considering continuous export of methanol, with the current information would result in a 10 fold increase in risk, as it was considered only to be operable 10% of the time. Thus the risk would still be below 5E-6.

## *Figure 6-1 Methanol Plant Risk Contours*

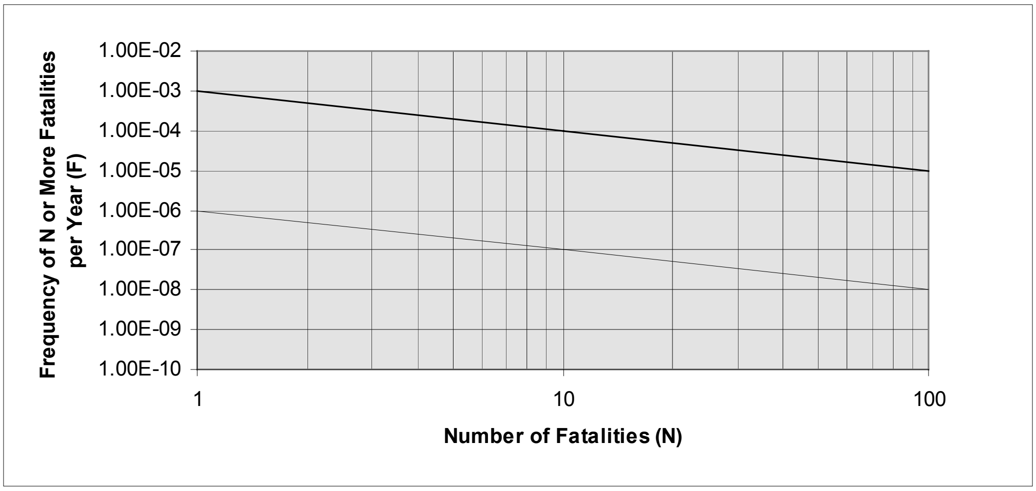


**Calculation of Societal Risk**
Societal risk is measured by means of an F-N curve for offsite personnel, which is calculated in the Riskplot II package.

The principal difference between individual risk and societal risk is that, whilst individual risk is a measure of the risk to a defined individual moving around a number of locations (or of any individual in a defined location - ie. risk contours), societal risk is a measure of the risk to a defined number of persons. The F-N curve expresses societal risk by charting the number of fatalities against the frequency of accidents capable of inflicting that number, or greater.

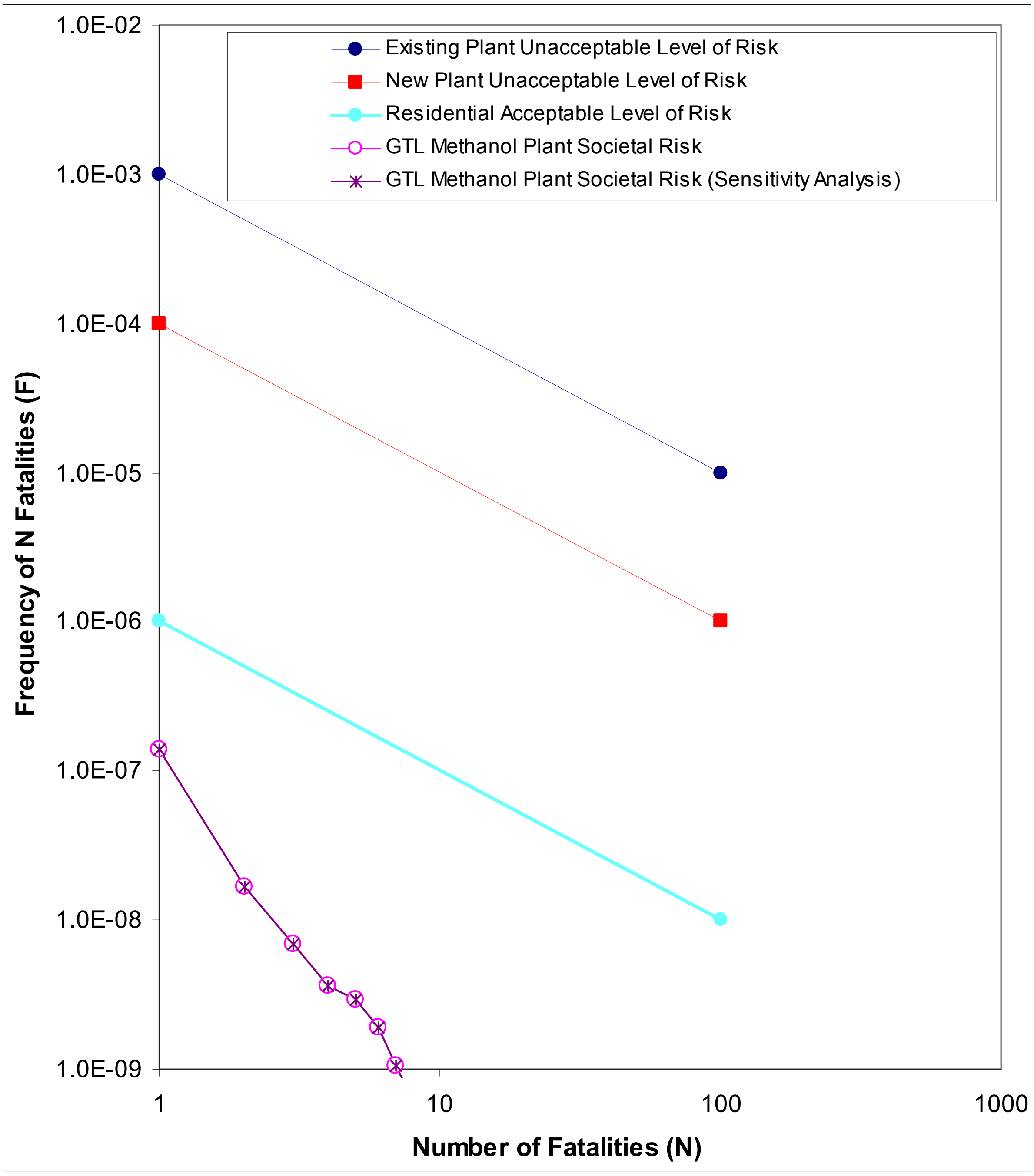
For the Methanol Plant analysis, the criterion used to assess societal risk is presented in Figure 6-2 for ease of reference. In the Figure, societal risk levels between the lines are 'ALARP'; whilst risks above the upper line are unacceptable, and risks below the lower line are negligible.

***Figure 6-2 : WA Societal Risk Criteria used on the GTL Methanol Plant***




The societal risks calculated for the Methanol Plant are presented in Figure 6-3 below.

***Figure 6-3 : GTL Methanol Plant FN Curve***



## 6.7 Assessment of Results

### 6.7.1 Individual Risk

The IRPA criteria as stated in EPA Bulletin 611 [5] are:

a A risk level in residential zones of one in a million per year ($1\times10^{-6}$) or less, is so small as to be acceptable to the Environmental Protection Authority.

b A risk level in "sensitive developments", such as hospitals, child care facilities and aged care housing developments of between one half and one in a million per year ($5x10^{-7}$ to $1\times10^{-6}$) is so small as to be acceptable to the Environmental Protection Authority.

c Risk levels from industrial sites should not exceed a target of fifty in a million per year ($5\times10^{-5}$) at the site boundary for each individual industry, and the cumulative risk level imposed on an industry should not exceed a target of one hundred in a million per year ($1\times10^{-4}$).

d A risk level for any non-industrial activity located in buffer zones between industrial facilities and residential zones of ten in a million per year ($10\times10^{-6}$) or lower, is so small as to be acceptable to the Environmental Protection Authority.

The Individual Risk contours are presented in Figure 6-1.

The events of concern were the catastrophic failure of one of the two largest inventory holders, the methanol storage tanks, and the release of carbon monoxide. The storage tanks provide the possibility for a large fire, which may be difficult to control, that could have off-site effects. The carbon monoxide releases are the only toxic releases that have the ability to affect areas outside the plant boundary, and this is only under certain circumstances.

### 6.7.2 Impact on Adjacent Facilities

The $5x10^{-5}$ risk contour from the GTL Methanol Plant does not extend beyond the site boundary. The $10\times10^{-6}$ contour extends to north and south from the site boundary, but is within 400 m of this boundary. Currently (2001/2002) there are no proposed uses for the surrounding land. Therefore the plant is considered to comply with the EPA Criteria [5] for individual risk.

### 6.7.3 Cumulative Risks

The Woodside Onshore Treatment Plant (LNG) is located approximately 1 km west from the GTL site boundary. The risk contours for the LNG plant, Appendix A, show the $1x10^{-6}$ contour extends from the eastern boundary of the processing equipment by approximately 400 m, and does not enter into the Withnell East Industrial Area.

The $5x10^{-7}$ does not extend beyond the Withnell East Industrial Area boundary of the western side, as seen in figure 6-1.

The two sites pose negligible risk to each other.

### 6.7.4 Toxic Risks

The toxic risks from this plant are a result of the carbon monoxide produced in the reforming stages and consumed in the methanol synthesis section. This poses negligible risk offsite.

### 6.7.5 Offsite Flammable Risks

There are minimal offsite fatal impacts from methane, methanol or hydrogen releases.

The maximum risk at the wharf is below 0.5E-6 per annum for the estimate operation of 10% of the time, equating to a maximum risk of 5E-6 if exporting was to occur continuously. This is acceptable for the operation of an industrial activity, especially with the inclusion of an exclusion zone, which should be determined once the final wharf design is made available, so an accurate assessment can be made.

### 6.7.6 Societal Risks

The Societal Risk (FN Curve) from the Methanol Plant is given in Figure 6-3.

As seen in Figure 6-3, the societal risk from this plant lies below the maximum for new plants within Western Australia.

### 6.7.7 Risk Reduction Measures

Throughout this document, a number of risk reduction measures have been identified for the GTL Methanol Plant.

Overall, a total of seven (7) potential risk reduction measures have been identified. Of these, some may be able to be implemented without the need for any form of cost benefit analysis, either because they are already justified on other grounds or because there is minimal cost involved.

The risk reduction measures to be considered for this facility are in Table 6-14.

***Table 6-14 : Proposed Risk Reduction Measures***

| | **Risk Reduction Measures** |
|---|---|
| 1. | Develop a Safety Management Plan |
| 2. | Put in place an Emergency Response Plan that provides a rapid response to identified releases that would facilitate early manual isolation of any leaking equipment |
| 3. | Develop a Joint Industrial Integrated Emergency Management Plan with Woodside. |
| 4. | Ensure fire fighting measures such as deluge systems are addressed and incorporated in the final design. |
| 5. | Ensure the gas detection systems in the final design include sensors for the fuel gas and $CO_2$ in areas that are both enclosed and open to increase likelihood of the detection of leaks. |
| 6. | Ensure the final design of the offloading systems incorporate shutdown systems that can be controlled by the operator at the loading point. |
| 7. | Designate an exclusion zone during loading of the export tankers at the wharf. This will be assessed when the final wharf and offloading system are designed. |

# 7 CONCLUSIONS

Risks from the GTL Methanol Plant are considered acceptable for a PRA, provided risk reduction measures are undertaken.

That is, the 50E-6 risk contour from the plant does not extend beyond the site boundary. The 10E-6 contour extends no more than 200m from the north and south of the site boundary. The area north of the plant is within the Withnell East Industrial Estate and the road which the 10E-6 contours passes over is for private use to access a communications tower. Neither of these two aspects of the area to the north of the plant are considered open and active, thus the situation falls within the criteria. The area to the south of the plant is conservation land with elements that are significant to aboriginal heritage. However, there are no areas designated as "significant" heritage location within the 10E-6 contour. The infrequent use of the land means this level of risk is acceptable [25]. Therefore the plant is considered to comply with the EPA Criteria [5] for individual risk.

The risks associated with elements of this facility that are offsite, the export pipe line and wharf, are within acceptable risk levels. This is based on minimal information, however risk assessments of the final pipeline easement and wharf will be required when design is finalised.

The various risk contours considered for the GTL Methanol Plant are presented in Figure 1-1 in the Executive Summary. Also, as can be seen in Figure 1-2 (in the Executive Summary), the societal risk from the plant satisfies the societal risk criteria as the F-N curve lies beneath the limit of unacceptable risk for new plants.

The Risk Assessment of the GTL Methanol Plant was developed using generic failure frequencies. For these values to be valid the safety management must be of a standard at least equal to norm of the plants on which these frequencies are based.

# 8 RECOMMENDATIONS

To ensure the plant is of acceptable standard, QEST Consulting Engineers recommend that a Safety Management System is developed and implemented. This Safety Management System should include the following elements as a minimum: Policy and Objectives, Organisation and Responsibility, Employee Selection, Competency and Training, Contractors and Support Services, Management of Change, and Performance Audit and Review.

In particular an Emergency Management Plan should be developed which would include interaction with Woodside.

It should be noted that the basis of this Study was conducted using preliminary drawings with limited access to information about the facility. It is therefore recommended that a thorough Quantitative Risk Assessment be completed prior to the commencement of construction and production operations.

The pipeline easements and wharf need to be accurately assessed when final designs are available so appropriate exclusion zones can be applied.

Appropriate warnings placed to the south of the plant within the conservation area to identify the risks associated being in the area should be put in place.

# 9 REFERENCES

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2. National Standard and Code of Practice for Control of Major Hazard Facilities, Worksafe (September, 1996).
3. AS 2885, Pipelines - Gas and Liquid Petroleum, Part 1 Design and Construction, Draft (December, 1996).
4. CPR 16E 'Methods for the determination of possible damage to people and objects resulting from releases of hazardous materials', TNO (1989).
5. EPA Bulletin 611.
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7. E&P Forum Report no 11.8/250, Quantitative Risk Assessment Datasheet Directory (October 1996).
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13. Lloyds Register. Reliability and Safety Assessment Methods for Ships and Other Installations (May 1983).
14. Kletz (1977) Unconfined vapour cloud explosions. In *Loss Prevention*, vol II (New York: Am. Inst. Chem. Engrs), p 50
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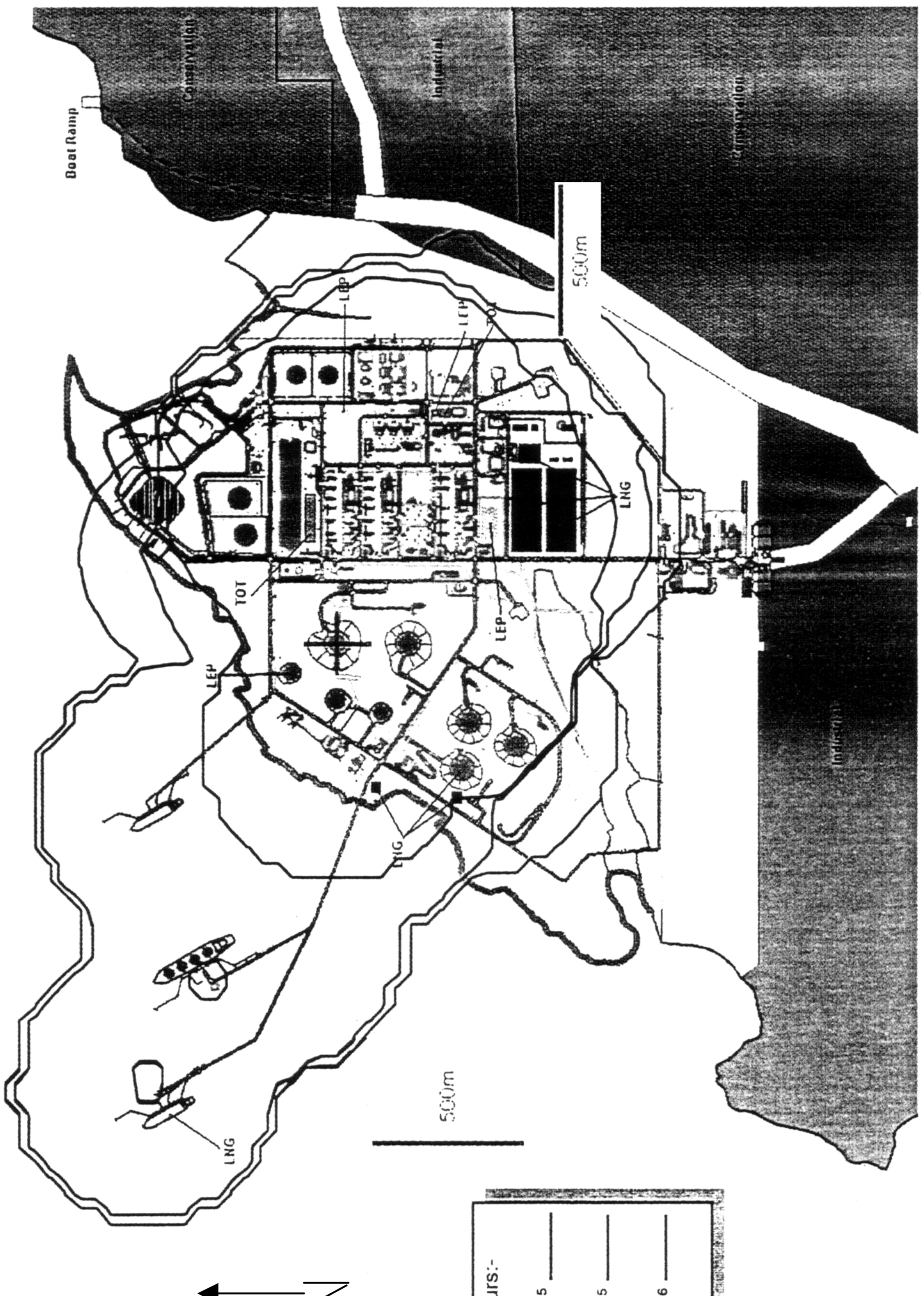
20. Dampier Port Area population data provided by telephone conversation between Dampier Port Authority representative and Jason Muirhead of Qest, 12th June 2001.
21. Woodside plants population data provided by telephone conversation between Woodside Energy Ltd representative and Philip Doray of Qest, 13th June 2001.
22. Telephone conversation between Mhairi Angus (Woodside) and Jason Muirhead (QEST), 20th December 2001.
23. Brennan, E. G, and Peachey, J. H., *Recent Research into Formal Safety Assessment for Shipping*, Lloyd's Register Technical Association
24. Telephone conversation between Melissa Monaghan and Greg Trembarth (Dampier Port Authority), 24th December 2001.
25. Email (29/04/2002) from John Clark, Wanati Pty Ltd, to Jason Muirhead, QEST.

# 10 APPENDICES

# APPENDIX A Woodside Onshore LNG Plant Risk Contours

The following diagram is Figure 5.4 “Risk Contours of Existing Plant plus Liquids Expansion, 2nd Trunkline Onshore Terminal / Domgas Expansion and LNG Trains 4&5 LNG Expansion” from the “Onshore Gas Plant – Trains 4&5 Expansion Preliminary Risk Assessment” completed by DnV Technica. This is included as Appendix H in *North West Venture Additional LNG Facilities PER*, Woodside November 1998.



# APPENDIX B Technical Diagrams

The process flow diagrams and other technical diagrams used are available on request;

P&ID 020150-001 Legend, Part 1

P&ID 020160-002 Legend, Part 2

P&ID 020160-003 Legend, Part 3

P&ID 020160-101 Unit 100 Reforming Desulphurization

P&ID 020160-102 Unit 100 Reforming Steam Reformer

P&ID 020160-103 Unit 100 Reforming HP-Steam Superheat I + II

P&ID 020160-104 Unit 100 Reforming Comb. Air Preheaters/Fans

P&ID 020160-105 Unit 100 Reforming Fuel Gas System

P&ID 020160-108 Unit 100 Reforming Autothermal Reformer

P&ID 020160-109 Unit 100 Reforming HP-Steam Drum/WHB

P&ID 020160-110 Unit 100 Reforming N.G. Compressor/Preheater

P&ID 020160-111 Unit 100 Reforming MP-Steamer Drum/Boiler

P&ID 020160-112 Unit 100 Reforming Reformed Gas Cooling

P&ID 020160-201 Unit 200 Methanol Synthesis Make Up and Recycle Gas Compressor

P&ID 020160-202 Unit 200 Methanol Synthesis Recycle Gas Cooling

P&ID 020160-203 Unit 200 Methanol Synthesis Methanol Reactors and ST. Drum

P&ID 020160-301 Unit 300 Methanol Distillation Prerun Column

P&ID 020160-302 Unit 300 Methanol Distillation Prerun Column Reflux

P&ID 020160-303 Unit 300 Methanol Distillation Pure Methanol Pressure Column

P&ID 020160-304 Unit 300 Methanol Distillation Pure Methanol Reflux Vessel

P&ID 020160-305 Unit 300 Methanol Distillation Pure Methanol Atm. Column

P&ID 020160-306 Unit 300 Methanol Distillation Atm Col. Ref. And Prod. Dischar.

P&ID 020160-307 Unit 300 Methanol Distillation Slop System

P&ID 020160-401 Unit 400 Intermediate Methanol Tanks

P&ID 020160-910 Unit 1000 Flare System

P&ID 020160-912 Unit 1100 Tank Farm

P&ID 020160-913 Unit 1100 Loading System

P&ID 020160-991 Unit 1900 Interconnecting Process System

PFD 011430-101 Plant Unit 100 Autoth. Reform. & Reformed Gas Waste Heat System

PFD 011430-102 Plant Unit 200 Steam Reformer and Flue Gas Waste Heat System

PFD 011430-201 Plant Unit 200 Methanol Synthesis

PFD 011430-301 Plant Unit 300 Methanol Distillation

PFD 011430-401 Plant Unit 400/1100 Methanol Tanks/Loading System

# APPENDIX C Hazard Register

The Hazard Register may result in further risk reduction measures or actions which will requires the allocation of personnel for each action. This is included during the Hazard Identification workshop held during the detailed design.

# Methanol Plant PRA HAZID 13th August 2001

| NODE DESCRIPTION & NOTES | ***Review of major hazardous inventories*** |
|---|---|
| *Aim: to review and agree what are the major hazards in terms of chemicals at the plant* | |

| NODE STUDIED | ***Node 1 – Major process hazardous fluids*** | | | | |
|---|---|---|---|---|---|
| **GUIDEWORD** | **POTENTIAL HAZARDS AND EFFECTS** | **THREATS / RISK COMMENTS** | **CONTROLS** | **ACTION** | **BY** |
| ***1.1 Process liquids*** | | | | | |
| Condensate | Loss of containment | Equipment failure, Fire risk | Installation specs, pressure and leak testing, maintenance system, firefighting facilities, operational procedures. | | |
| Methanol | Loss of containment | Equipment failure<br>Fire risk or human contact risk | Installation specs, pressure and leak testing, maintenance system, operational procedures, COSH procedures, PPE, firefighting facilities, bunding of storage vessels. | | |
| ***1.2 Process gases & vapours*** | | | | | |

| NODE STUDIED | ***Node 1 – Major process hazardous fluids*** | | | | |
|---|---|---|---|---|---|
| **GUIDEWORD** | **POTENTIAL HAZARDS AND EFFECTS** | **THREATS / RISK COMMENTS** | **CONTROLS** | **ACTION** | **BY** |
| Methane (natural gas) | Loss of containment | Equipment failure<br>Fire, explosion | Firefighting facilities, ESD valves, blowdown, fire and gas detection in enclosed spaces. | | |
| Methanol (vapour) | Loss of containment | Equipment failure<br>Fire risk<br>Occupational risk | Firefighting facilities, ESD valves, blowdown, fire and gas detection in enclosed spaces. | | |
| Hydrogen | Loss of containment - Intermediate product | Equipment failure<br>Fire, explosion risk | Plant design, detection procedures.<br>Firefighting facilities | | |
| Carbon monoxide | Loss of containment - Intermediate product | Equipment failure | Specifications | | |
| Carbon dioxide | Loss of containment - Intermediate product | Equipment failure<br>Corrosion | Specifications | | |
| Nox | Loss of containment - Contaminants in feed gas | Equipment failure<br>Environmental risk | Feed gas specification. | | |
| Sox | Loss of containment - Contaminants in feed gas | Equipment failure | Feed gas specification. | | |
| $H_2S$ | Loss of containment - $H_2S$ in the feed gas | Equipment failure<br>Occupational risk | Small volume | Not envisaged as being an issue. | |
| Nitrogen | Loss of containment - Intermediate product (present at the reformer outlet). | Equipment failure<br>Occupational risk | Small volume | | |
| SynGas | Loss of containment - Intermediate product | Equipment failure<br>Fire, explosion risk | Specifications<br>Firefighting facilities | | |

| NODE STUDIED | *Node 1 – Major process hazardous fluids* | | | | |
|---|---|---|---|---|---|
| **GUIDEWORD** | **POTENTIAL HAZARDS AND EFFECTS** | **THREATS / RISK COMMENTS** | **CONTROLS** | **ACTION** | **BY** |
| Steam | Loss of containment | Equipment failure<br>Occupational risk | Trained personnel.<br>Hazard awareness. | | |
| Flue gas | Loss of containment (Process product) | Equipment failure<br>Fire, explosion risk | Specifications<br>Firefighting facilities | | |
| Oxygen | Loss of containment | Explosive, contamination | Plant design, detection procedures. | | |
| ***1.3 Process solids*** | | | | | |
| Hazardous Catalysts | Loss of containment | Equipment failure | Handling procedures<br>Training | | |
| Catalysts | Loss of containment | Equipment failure | Handling procedures<br>Training | | |

| NODE DESCRIPTION & NOTES | ***Plant facilities and operations hazards*** |
|---|---|
| *Hazards associated with the plant and its operation, excluding the pipeline and tanker loading* | |

| NODE STUDIED | *Node 2 – Plant facilities and operations hazards* | | | | |
|---|---|---|---|---|---|
| **GUIDEWORD** | **POTENTIAL HAZARDS AND EFFECTS** | **THREATS / RISK COMMENTS** | **CONTROLS** | **ACTION** | **BY** |
| **Section 1 : External and Environmental Hazards** | | | | | |
| ***1.1 Natural and Environmental Hazards*** | | | | | |
| Climate Extremes – wave & wind | Cyclones | Potential impact on storage tanks.<br>Drains overflowing. | Plant designed to cyclone standards.<br>Storm surges accommodated in design (caters for 100 year storm event). | | |
| Lightning | Lightning strike. | | Plant earthing design and compliance with design standards. | | |
| Earthquakes | Not envisaged as being an issue. | | | | |
| Erosion | Not envisaged as being an issue. | | | | |
| Subsidence | Not envisaged as being an issue. | | | | |
| ***1.2 Created (man-made) Hazards*** | | | | | |
| Security hazards | Not envisaged as being an issue. | | Perimeter fence + security. | | |
| Terrorist activity | Not envisaged as being an issue. | | Perimeter fence + security. | | |

| NODE STUDIED | *Node 2 – Plant facilities and operations hazards* | | | | |
|---|---|---|---|---|---|
| **GUIDEWORD** | **POTENTIAL HAZARDS AND EFFECTS** | **THREATS / RISK COMMENTS** | **CONTROLS** | **ACTION** | **BY** |
| ***1.3. Effect of facility on the surroundings & visa versa*** | | | | | |
| Geographical - Infrastructure | Not envisaged as being an issue. | | | | |
| Proximity to population / Adjacent land use | Public recreation areas around site (Withnell Bay), Dampier & Karratha towns in vicinity. | No toxic impact - fire hazard only. | | | |
| Proximity to transport corridors | There are roads running close to the site. Development of area will lead to increased traffic load on local roads. | | One public road to beach access in Withnell Bay. None near plant. | | |
| ***1.4 Infrastructure*** | | | | | |
| Escape & Evacuation | Inability to escape from escalating event. | Only one sealed road for all to escape via (including Woodside personnel). | 2 to 3 egress points from plant. | | |
| **Section 2 : Facility Hazards** | | | | | |
| ***2.1 Facility Hazards - Control Methods / Philosophy*** | | | | | |
| Maintenance Philosophy | | | Asset management plan. | | |
| Control philosophy | N/A for new plant | | New design | | |

| NODE STUDIED | *Node 2 – Plant facilities and operations hazards* | | | | |
|---|---|---|---|---|---|
| **GUIDEWORD** | **POTENTIAL HAZARDS AND EFFECTS** | **THREATS / RISK COMMENTS** | **CONTROLS** | **ACTION** | **BY** |
| Manning Levels | Low due to plant mainly automated – mainly in admin area or control room. | | | | |
| Emergency Response | Onsite ER team – security will be involved, local authorities, own fire team, staff trained accordingly. | | Training<br>Competency system<br>There is a nursing post and ambulance at Woodside. | | |
| Simultaneous Operations | Potential for personnel injuries/fatalities during SIMOPS | Lack of awareness<br>Not following procedures | PTW, JSA, planning process, induction, communications, alarm systems. | | |
| Start-up / Shutdown | Human error - failure to follow correct sequence of start-up / shutdown. | Infrequent events.<br>Lack of familiarity with process / equipment. | Documented procedures.<br>Trained personnel, quality procedures, competency system, communications, ergonomics, adequate manning and supervision. | | |

| NODE STUDIED | ***Node 2 – Plant facilities and operations hazards*** | | | | |
|---|---|---|---|---|---|
| **GUIDEWORD** | **POTENTIAL HAZARDS AND EFFECTS** | **THREATS / RISK COMMENTS** | **CONTROLS** | **ACTION** | **BY** |
| ***2.2 Facility Hazards - Fire & Explosion Hazards*** | | | | | |
| Sources of Ignition | Electricity,<br>Combustion,<br>flare,<br>Maintenance activities (eg welding, grinding etc) | Fire risk | No components that spontaneously combust.<br>No smoking policy.<br>PTW, JSA and maintenance procedures. | | |
| Equipment Layout | Major equipment located too close to each other. | Modular construction | Design philosophy to maximize separation to minimize escalation.<br>Risk assessment. | | |
| Fire Protection & Response | Escalation of fire to neighbouring process equipment. | Failure of fire detection | Permanently installed fire water system – ringmain, deluge systems.<br>Redundancy in fire detection systems.<br>Fire team.<br>VESDA or equivalent around site.<br>Comply with NFPA standards.<br>Testing program, fail safe system.<br>Risk assessment. | | |

| NODE STUDIED | *Node 2 – Plant facilities and operations hazards* | | | | |
|---|---|---|---|---|---|
| **GUIDEWORD** | **POTENTIAL HAZARDS AND EFFECTS** | **THREATS / RISK COMMENTS** | **CONTROLS** | **ACTION** | **BY** |
| Operator Protection | Exposure of personnel to fire and toxic hazards from process inventory. | | Operators operate remotely from control room – when doing visual inspections will wear appropriate PPE.<br>COSH procedures, maintenance, hazard awareness.<br>Risk assessment. | | |
| ***2.3 Facility Hazards - Process Hazards*** | | | | | |
| Release of Inventory | Catastrophic loss of containment | Vessel burst, external corrosion. | PTW system in place.<br>Regular inspection of equipment.<br>Certified vessels. | | |
| Over Pressure | Vessel rupture, pipeline or valve failure. | Pressure differences through the process.<br>Explosion overpressure - congestion | Pressure relief devices in place.<br>Alarms, cooling, maintenance system, certification system.<br>Risk assessment. | | |
| Over / Under Temperature | Cryogenics | Over or under temperature. | Specifications and inventory control.<br>Control systems and ESD in place.<br>Hot Spot Management system.<br>Annulus so no leaks direct to atmosphere. | | |

| NODE STUDIED | *Node 2 – Plant facilities and operations hazards* | | | | |
|---|---|---|---|---|---|
| **GUIDEWORD** | **POTENTIAL HAZARDS AND EFFECTS** | **THREATS / RISK COMMENTS** | **CONTROLS** | **ACTION** | **BY** |
| Excess / Zero Level | Overfill storage tanks | Instrumentation or equipment failure | Control systems, alarm and ESD in place.<br>All equipment is redundant / fail safe.<br>Bunding, water sprays, level control, automated local and external alarms. | | |
| Corrosion | Loss of containment | | Corrosion allowance in design.<br>Protective coatings. | | |
| Erosion | No solids | | | | |
| Impacts | Dropped objects, vehicle collision | | No vehicles on site.<br>Forklift trucks only in stores – if on site then only during plant shutdown/maintenance.<br>No lifting over live equipment.<br>PTW, JSA, planning process, induction, communications | | |

| NODE STUDIED | *Node 2 – Plant facilities and operations hazards* | | | | |
|---|---|---|---|---|---|
| **GUIDEWORD** | **POTENTIAL HAZARDS AND EFFECTS** | **THREATS / RISK COMMENTS** | **CONTROLS** | **ACTION** | **BY** |
| ***2.4 Facility Hazards - Utility Systems*** | | | | | |
| Firewater Systems | Escalation of fire to neighbouring process equipment. | Failure of fire detection | Permanently installed fire water system – ringmain, deluge systems.<br>Fire team.<br>VESDA or equivalent around site.<br>Comply with NFPA standards.<br>Testing program, fail safe system.<br>Risk assessment. | | |
| Fuel gas | Loss of containment | Fire, explosion | Firefighting facilities, ESD valves, blowdown, fire and gas detection in enclosed spaces. | | |
| Diesel Fuel | Diesel Fuel for emergency generator. | | | | |
| Power Supply | Not envisaged being an issue. | | | | |
| Steam | Loss of containment | Fittings / Equipment failure | Trained personnel,<br>Hazard awareness. | | |
| Inert gas | Not envisaged being an issue. | | | | |
| Flare system | | Radiation | Location, wind conditions | | |

**Node 3 –Pipeline (s)**

| NODE STUDIED | ***Node 3 –Pipeline*** | | | | |
|---|---|---|---|---|---|
| **GUIDEWORD** | **POTENTIAL HAZARDS AND EFFECTS** | **THREATS / RISK COMMENTS** | **CONTROLS** | **ACTION** | **BY** |
| **Section 1 : External and Environmental Hazards** | | | | | |
| ***1.1 Natural and Environmental Hazards*** | | | | | |
| Earthquakes | Pipeline damage | | Site is low earthquake region, design in accordance with local standard. | | |
| Erosion / subsidence | Not envisaged to be an issue. | | Buried to bedrock level | | |
| ***1.2. Effect of facility on the surroundings*** | | | | | |
| Geographical - Infrastructure | Public recreation areas around site (popular beaches), Dampier & Karratha towns in vicinity. | | Access road to recreation areas / neighbouring towns not within close proximity to pipeline location. | | |
| Proximity to population / Adjacent land use | There are roads running close to the site.<br>Development of area will lead to increased traffic load on local roads. | Close to Woodside facilities. | | | |

| NODE STUDIED | *Node 3 –Pipeline* | | | | |
|---|---|---|---|---|---|
| **GUIDEWORD** | **POTENTIAL HAZARDS AND EFFECTS** | **THREATS / RISK COMMENTS** | **CONTROLS** | **ACTION** | **BY** |
| ***1.3 Infrastructure*** | | | | | |
| Emergency Response | | | Port authorities.<br>Training, competency system, nursing post and ambulance at Woodside.<br>ER team – security will be involved, local authorities, own fire team. | | |
| Start-up / Shutdown | Not envisaged as being an issue. | | | | |
| ***2.1 Facility Hazards - Fire & Explosion Hazards*** | | | | | |
| Sources of Ignition | N/A | | | | |
| Fire Protection & Response | N/A | | | | |
| ***2.2 Facility Hazards - Process Hazards*** | | | | | |
| Release of Inventory | Catastrophic loss of containment | Pipeline burst, external corrosion. | No internal corrosion or erosion.<br>Regular inspection of pipelines. | | |
| Over Pressure | Catastrophic loss of containment | Pipeline burst, | Pipeline integrity system (monitoring and measurement) | | |
| Over / Under Temperature | Not envisaged as being an issue. | | | | |

| NODE STUDIED | ***Node 3 –Pipeline*** | | | | |
|---|---|---|---|---|---|
| **GUIDEWORD** | **POTENTIAL HAZARDS AND EFFECTS** | **THREATS / RISK COMMENTS** | **CONTROLS** | **ACTION** | **BY** |
| Excess / Zero Level | Not envisaged as being an issue. | | | | |
| Corrosion | Loss of containment | | Corrosion allowance in design.<br>Protective coatings.<br>If appropriate, inject inhibitor.<br>Hydrotest before commissioning. | | |
| Erosion | Not envisaged as being an issue. | | | | |
| Impacts | Not envisaged as being an issue. | | | | |

**Node 4 – Product Off-loading at Jetty**

| NODE STUDIED | ***Node 4 – Tanker Loading hazards*** | | | | |
|---|---|---|---|---|---|
| **GUIDEWORD** | **POTENTIAL HAZARDS AND EFFECTS** | **THREATS / RISK COMMENTS** | **CONTROLS** | **ACTION** | **BY** |
| **Section 1 : External and Environmental Hazards** | | | | | |
| ***1.1 Natural and Environmental Hazards*** | | | | | |
| Climate Extremes – wave & wind | Impact on loading of tankers. | Spills on land / sea | Ships not allowed in port during cyclones.<br>Contingency plan in the event of a spill. | | |
| Lightning | Not envisaged as being an issue. | | | | |

| NODE STUDIED | *Node 4 – Tanker Loading hazards* | | | | |
|---|---|---|---|---|---|
| **GUIDEWORD** | **POTENTIAL HAZARDS AND EFFECTS** | **THREATS / RISK COMMENTS** | **CONTROLS** | **ACTION** | **BY** |
| Earthquakes | Not envisaged as being an issue. | | Site is low earthquake region. | | |
| ***1.2 Created (man-made) Hazards*** | | | | | |
| Security hazards | Not envisaged as being an issue. | | | | |
| Terrorist activity | Not envisaged as being an issue. | | | | |
| **Section 2 : Facility Hazards** | | | | | |
| ***2.1 Facility Hazards - Control Methods / Philosophy*** | | | | | |
| Control philosophy | N/A | | | | |
| Manning Levels | N/A | | Low manning level – one person to operate valve. Stevedores to perform offloading operations.<br>Minimum manning level philosophy. | | |
| Emergency Response | | | Port authorities. | | |
| ***2.2 Facility Hazards - Fire & Explosion Hazards*** | | | | | |
| Sources of Ignition | N/A | | | | |
| Equipment Layout | N/A | | | | |
| Fire Protection & Response | N/A | | | | |

| NODE STUDIED | ***Node 4 – Tanker Loading hazards*** | | | | |
|---|---|---|---|---|---|
| **GUIDEWORD** | **POTENTIAL HAZARDS AND EFFECTS** | **THREATS / RISK COMMENTS** | **CONTROLS** | **ACTION** | **BY** |
| Operator Protection | Hazard to personnel during offloading. | | Use of appropriate PPE. | | |
| ***2.3 Facility Hazards - Process Hazards*** | | | | | |
| Release of Inventory | Human error – incorrect offloading procedure. | Spill on sea / land | Documented procedures.<br>Trained personnel. | | |
| Over Pressure | N/A | | | | |
| Over / Under Temperature | N/A | | | | |
| Excess / Zero Level | Overfilling of tankers. | | Control systems, alarm and ESD in place. | | |
| Corrosion | N/A | | | | |
| Erosion | N/A | | | | |
| Impacts | N/A | | | | |

# APPENDIX D EPA Guidelines

**WESTERN AUSTRALIA**
**ENVIRONMENTAL PROTECTION AUTHORITY**

**GUIDELINES FOR A PRELIMINARY RISK ANALYSIS**

**Introduction:**

The Environmental Protection Authority may, in accordance with the Environmental Protection Act, 1986, require a proposal which may have a significant impact on the environment, to undergo environmental impact assessment. If that proposal has associated hazards which present risks to life (hereinafter referred to as risk) the Authority may request that a 'Preliminary Risk Analysis' (PRA) be done as part of the environmental assessment process.

Proposals for which a PRA may be required include those which involve the manufacture, storage or transport of dangerous goods, rezoning of land which may result in the exposure of more people to higher risks, or for any other proposal which may increase risk.

These guidelines provide an overview of the issues to be addressed in a PRA. The guidelines primarily address the construction of new hazardous industry, however, the approach can be used for other types of proposals (rezoning of land etc). The guidelines are not prescriptive and it is the responsibility of the proponent to ensure that the PRA addresses all relevant issues.

The amount of detail required by the EPA for a particular proposal will vary with the nature and complexity of the proposal. A proposal for a small factory handling a highly toxic chemical may require a more detailed PRA than a large development in which materials of low hazard are involved. The proponent and the risk analyst should discuss and agree, with the EPA and its advisers, the details of the PRA both before and during the preparation of the PRA.

The analysis must be transparent to the extent that the EPA and its advisers can judge the adequacy of the analysis, and so they are also able to audit the analysis. This will often require the provision of commercially sensitive information, and arrangements will be made to ensure the confidentiality of that information is maintained.

In the PRA, the risk analyst is expected to make implementable and auditable recommendations regarding the safety design and operation of the proposed facility. The proponent is expected to make a commitment to implement these recommendations. The commitment will form part of the legally binding Environmental Conditions set by the Minister for the Environment on the proposal, should the Minister give approval for the proposal to proceed. The "as built" plant, operation or development is expected to achieve essentially the same or lower levels of risk than presented in the PRA.

The risk analyst must be independent of the proponent and have demonstrated experience with the type of plant being proposed. The risk analyst must demonstrate this autonomy and capability to the satisfaction of the EPA prior to accepting a commission from the proponent. The risk analyst must formally certify the accuracy and veracity of work completed in the PRA. These requirements are outlined in more detail in EPA Bulletin 611, "Criteria for the Assessment of Risk from Industry".

All PRAs submitted to the EPA must as a minimum have the following contents in the order specified below. This will simplify the review of submissions and result in faster review times.

**1. Summary**

The document must contain a clear and concise summary of the PRA, and include a statement on whether the results of the analysis comply with the EPA risk criteria.

**2. Introduction**

(i) Background
(ii) Aims and objectives
(iii) Description and analysis of the proposal
(iv) Description of the risk analysis techniques used
(v) Risk standards and criteria used

**3. Proposal description**

(i) Location and environment of the proposed site, including:
- Map of the location of the proposed site, detailing existing, actual and future planned land use of the site and surrounding area as defined by the District Town Planning Scheme of a Local Authority and/or the Metropolitan Region Scheme.
- Susceptibility to natural disasters (earthquakes, floods, cyclones, sink holes etc);
- Location with respect to other hazardous industry;
- Location of required and existing transportation routes; and
- Proposed route(s) of services to the site (including electricity lines, fuel pipelines and process liquid and gas pipelines). The extent of service supply route information should be commensurate with the development stage of the proposal. However the EPA consider that preliminary discussions with the supply agency and necessary easements should have been determined in principle prior to submission to the EPA.

(ii) Process description including:
- Brief description of the process;
- General arrangements showing plant layout; and
- Simplified process flow diagrams.

(iii) Hazards associated with the proposal, including:
- Hazardous materials (list of materials and their hazardous properties);
- Hazards associated with the plant technology;
- History of safety performance of similar facilities;
- Statement listing the engineering codes and standards proposed by the proponent and used by the risk analyst to assess the likely reliability of the plant; and
- Review and report on the safety standards incorporated into the conceptual engineering design.

(iv) Any other activities in the potential impact zone of the proposed development shall be considered in the risk analysis and included in the report.

## 4. Hazard assessment

The techniques of a hazard assessment differ in detail from one proposal to another, however, the following approach must always be followed:

- Hazard identification (of a complete set of failure cases which could cause death);
- Consequence analysis (to determine the area which may result in death due to over pressure, radiation exposure or toxic gas exposure as a consequence of a failure);
- Frequency analysis (to estimate the probability of each failure case); and
- Quantified Risk Assessment (to cumulatively add the probabilities of failures which may result in death at varying distances and directions to produce contours of levels of imposed risk).

In the presentation of the hazard analysis the following information should be detailed in either the body of the report or as appendices:

(i) Hazard identification

- Failure cases of major process vessels (including details of operating temperature and pressure, inventory, storage and bunding details, types of failure considered, release rate, duration of the release, release mass etc);
- Failure cases of storage vessels (including details of operating temperature and pressure, inventory, storage and bunding details, types of failure considered, release rate, duration of the release, release mass etc); and
- Failure cases of piping, including service pipes (including details of operating temperature and pressure, inventories, types of failures considered, release rate, duration of the release, release mass etc).

Details shall be provided of the methods used for grouping of failure cases. Domino effects must be considered.

Potential sources of releases shall be identified, itemised (and grouped, if appropriate) and summarised.

(ii) Consequence analysis

- Description of methods/models used in calculating consequences of incidents, including input data and assumptions. The Appendices should contain a more comprehensive description of the methods including values of, and references for, all coefficients;
- Where the consequence analysis involves gas dispersion modelling, details are required on topography and meteorology (wind speed and direction, atmospheric stability, surface roughness length and any other parameter relevant to risk analysis). If the wind speed-direction-stability information has been condensed from more detailed information, the method of reduction should be described and justified in an Appendix; and
- Details are required on toxicity, radiation exposure or over pressure values (together with references) used in the consequence analysis. Probit equations (and references) are also to be presented.

Computer printouts of the results should be included in the Appendices.

(iii) Frequency analysis

- A table is to be provided of generic or unit failure frequencies used (fully referenced). The EPA may request that the proponent provides the relevant literature to verify the applicability of failure frequencies used; and
- If the PRA incorporates the use of safety devices the failure rate per demand must be included in the analysis.

(iv) Quantified Risk Assessment

- A table of incidents should be presented; and
- Individual risk contours should be presented for the following risk values: $10^{-4}$, $10^{-5}$, $10^{-6}$, $10^{-7}$ and $10^{-8}$ deaths per person per year.

An error analysis should be included in the Appendix indicating the accuracy or range of all of the input variables and models used, including failure frequency data, impact or toxicity data, consequence models, and confidence limits on the risk contours.

**5. Risk analysis**

(i) Incorporation of the risk levels from this proposal into any cumulative risk analysis for the local area is required. This applies particularly to the Kwinana Industrial Area, the Kemerton Industrial Park, and North Fremantle. The State government has assisted in this matter in some cases.
(ii) Report the results of the risk values determined in the hazard assessment and compare them to the EPA risk criteria or other relevant criteria.
(iii) Regardless of whether there is compliance with the EPA or other risk criteria, discuss how the incidents contributing most to risk, or having the most serious consequences, may be controlled. Relevant factors to consider may include the installation of safety devices, alternative methods and volumes of storage, modified layout, specific recommendations on aspects to be incorporated in emergency planning, etc. Any risk reduction measure which was incorporated as part of the analysis shall be fully documented.

**6. Conclusions**

Summary of the assumptions and results of the risk analysis, and conclusions as to site acceptability should be given. Implementable and auditable recommendations should be collated in this section.

May 1993

# APPENDIX E Assumption Register

| Number | Assumption |
|---|---|
| 1. | The GTL Methanol plant is to operate 24 hours per day, for 365 days per year. |
| 2. | Natural gas supply to the battery limits on site will be at 6.0 Mpag via a 219 mm diameter (OD) pipeline. |
| 3. | For the calculation of IRPA due to toxic releases the person is to be present in the one position for 60 minutes. |
| 4. | For the calculation of IRPA due to thermal events the person is to be present in the one position for 60 seconds. |
| 5. | The Site was assumed to have the following properties:<br>• The mean day time temperature is taken to be 302K;<br>• Ground temperature for day time is assumed to be 302K;<br>• The mean night time temperature is taken to be 288K;<br>• Ground temperature for night time is assumed to be 288K;<br>• Mean annual humidity is assumed to be 43%; and<br>• Roughness length for dispersion calculations is assumed to be 0.03m (corresponding to "flat land with few trees"). |
| 6. | All leaks are assumed to originate 1.0 m above ground level. |
| 7. | All jet leaks are assumed to be horizontal. |
| 8. | Leaks are assumed to be through a sharp-edged orifice with a leak path of negligible length. |
| 9. | Where 'rupture' leaks are modelled as initiating events, these are analysed as continuous leaks where the leak diameter is that of the largest connection attached to the vessel. |
| 10. | Spills are assumed to take place on the Phast option of "concrete". |
| 11. | Jet and pool fires are modelled using steady-state conditions given that Phast cannot model transient fires |
| 12. | Initial release rates can be used to define effect distances for dispersing gas clouds and jet fires |
| 13. | The export pump can be isolated within 60 seconds. |
| 14. | The export line to the wharf was assumed to have the following safety controls:<br>• Valves to be welded to pipework;<br>• Isolation valves at end of each pipeline which will automatically close on operation of ESD system; and<br>• Pressure monitoring of pipeline during operation for automatic monitoring of pipeline and activating ESD valves on sudden pressure drop. |
| 15. | Shipping Incident Frequency assumptions:<br>• The number of methanol exports per year is 36.<br>• The average vessel payload is 30,000 tonne.<br>• The average length is 220 m.<br>• The vessel arrives empty at the public jetty.<br>• The departing vessels are in the harbour for 1 hour.<br>• There will be approximately 280 vessels using the new channel each year.<br>• The average length of a large vessel is assumed to be 270 m.<br>• 20% of the collisions are severe enough to penetrate one of the tanks resulting in a significant release of methanol. |

# APPENDIX F Material Safety Data Sheets

The Material Safety Data Sheets for the following are attached:

- Methane,
- Hydrogen,
- Carbon monoxide, and;
- Methanol.

# International Chemical Safety Cards

## METHANE

ICSC: 0291

METHANE
(cylinder)
$CH_4$
Molecular mass: 16.0

CAS # 74-82-8
RTECS # PA1490000
ICSC # 0291
UN # 1971;1972
EC # 601-001-00-4

| TYPES OF HAZARD/ EXPOSURE | ACUTE HAZARDS/ SYMPTOMS | PREVENTION | FIRST AID/ FIRE FIGHTING |
|---|---|---|---|
| FIRE | Extremely flammable. | NO open flames, NO sparks, and NO smoking. | Shut off supply; if not possible and no risk to surroundings, let the fire burn itself out; in other cases extinguish with water spray, powder, carbon dioxide |
| EXPLOSION | Gas/air mixtures are explosive. | Closed system, ventilation, explosion-proof electrical equipment and lighting. | In case of fire: keep cylinder cool by spraying with water. Combat fire from a sheltered position. |
| EXPOSURE | | | |
| INHALATION | Unconsciousness. | Ventilation. Breathing protection if high concentration. | Fresh air, rest. Artificial respiration if indicated. Refer for medical attention. |
| SKIN | Serious frostbite. | Cold-insulating gloves. | ON FROSTBITE: rinse with plenty of water, do NOT remove clothes. Refer for medical attention. |
| EYES | | | |
| INGESTION | | | |

| SPILLAGE DISPOSAL | STORAGE | PACKAGING & LABELLING |
|---|---|---|
| Evacuate danger area! Consult an expert! Ventilation (extra personal protection: self-contained breathing apparatus). | Fireproof. Cool. Ventilation along the floor and ceiling. | F symbol<br>R: 12<br>S: 9-16-33<br>UN Hazard Class: 2.1 |

**SEE IMPORTANT INFORMATION ON BACK**

**ICSC: 0291**

# International Chemical Safety Cards

## METHANE

ICSC: 0291

| | | |
|---|---|---|
| IMPORTANT DATA | **PHYSICAL STATE; APPEARANCE:**<br>COLOURLESS, COMPRESSED OR LIQUEFIED GAS , WITH NO ODOUR.<br><br>**PHYSICAL DANGERS:**<br>The gas is lighter than air.<br><br>**CHEMICAL DANGERS:**<br><br>**OCCUPATIONAL EXPOSURE LIMITS (OELs):**<br>TLV: ppm; $mg/m^3$ simple asphyxiant (ACGIH 1993-1994).<br>MAK not established. | **ROUTES OF EXPOSURE:**<br>The substance can be absorbed into the body by inhalation.<br><br>**INHALATION RISK:**<br>On loss of containment this gas can cause suffocation by lowering the oxygen content of the air in confined areas.<br><br>**EFFECTS OF SHORT-TERM EXPOSURE:**<br>Contact with compressed or liquid gas may cause frostbite.<br><br>**EFFECTS OF LONG-TERM OR REPEATED EXPOSURE:** |
| **PHYSICAL PROPERTIES** | Boiling point: -161°C<br>Melting point: -183°C<br>Solubility in water, ml/100 ml at 20°C: 3.3<br>Relative vapour density (air = 1): 0.6 | Flash point: Flammable Gas<br>Auto-ignition temperature: 537°C<br>Explosive limits, vol% in air: 5-15 |
| **ENVIRONMENTAL DATA** | | |

**NOTES**

Density of the liquid at boiling point: 0.42 kg/l. The substance may travel to a source of ignition and flash back. High concentrations in the air cause a deficiency of oxygen with the risk of unconsciousness or death. Check oxygen content before entering area. Turn leaking cylinder with the leak up to prevent escape of gas in liquid state. After use for welding, turn valve off; regularly check tubing, etc., and test for leaks with soap and water. The measures mentioned in section PREVENTION are applicable to production, filling of cylinders, and storage of the gas.
Transport Emergency Card: TEC (R)-622, 20G04
NFPA Code: H 1; F 4; R 0;

# International Chemical Safety Cards

## HYDROGEN

ICSC: 0001

HYDROGEN
(cylinder)
$H_2$
Molecular mass: 2.0

CAS # 1333-74-0
RTECS # MW8900000
ICSC # 0001
UN # 1049
EC # 001-001-00-9

| TYPES OF HAZARD/ EXPOSURE | ACUTE HAZARDS/ SYMPTOMS | PREVENTION | FIRST AID/ FIRE FIGHTING |
|---|---|---|---|
| FIRE | Extremely flammable. Many reactions may cause fire or explosion. | NO open flames, NO sparks, and NO smoking. | Shut off supply; if not possible and no risk to surroundings, let the fire burn itself out; (see notes) water spray, powder, carbon dioxide. |
| EXPLOSION | Gas/air mixtures are explosive. | Closed system, ventilation, explosion-proof electrical equipment and lighting. Use non-sparking handtools. Do not handle cylinders with oily hands. | In case of fire: keep cylinder cool by spraying with water. Combat fire from a sheltered position. |
| EXPOSURE | | | |
| INHALATION | Dizziness. Asphyxia. Laboured breathing. Unconsciousness. | Closed system and ventilation. | Fresh air, rest. Refer for medical attention. |
| SKIN | ON CONTACT WITH LIQUID: FROSTBITE. | Cold-insulating gloves. Protective clothing. | ON FROSTBITE: rinse with plenty of water, do NOT remove clothes. Refer for medical attention. |
| EYES | | Safety goggles, or face shield. | |
| INGESTION | | | |

| SPILLAGE DISPOSAL | STORAGE | PACKAGING & LABELLING |
|---|---|---|
| Evacuate danger area! Consult an expert! Ventilation. Remove vapour with fine water spray. | Fireproof. Cool. | F+ symbol<br>R: 12<br>S: 9-16-33<br>UN Hazard Class: 2.1 |

**SEE IMPORTANT INFORMATION ON BACK**

**ICSC: 0001**

# International Chemical Safety Cards

## HYDROGEN

ICSC: 0001

| | | |
|---|---|---|
| IMPORTANT DATA | **PHYSICAL STATE; APPEARANCE:**<br>ODOURLESS , COLOURLESS COMPRESSED LIQUEFIED GAS<br><br>**PHYSICAL DANGERS:**<br>The gas mixes well with air, explosive mixtures are easily formed. The gas is lighter than air.<br><br>**CHEMICAL DANGERS:**<br>Heating may cause violent combustion or explosion. Reacts violently with air, oxygen, chlorine, fluorine, strong oxidants causing fire and explosion hazard. Metal catalysts, such as platinum and nickel, greatly enhance these reactions.<br><br>**OCCUPATIONAL EXPOSURE LIMITS (OELs):**<br>TLV not established | **ROUTES OF EXPOSURE:**<br>The substance can be absorbed into the body by inhalation.<br><br>**INHALATION RISK:**<br>On loss of containment this liquid evaporates very quickly causing supersaturation of the air with serious risk of suffocation when in confined areas.<br><br>**EFFECTS OF SHORT-TERM EXPOSURE:**<br>The liquid may cause frostbite. Exposure could cause dizzines, high voice. Exposure may result in suffocation.<br><br>**EFFECTS OF LONG-TERM OR REPEATED EXPOSURE:** |
| **PHYSICAL PROPERTIES** | Boiling point: - 253°C<br>Relative vapour density (air = 1): 0.07<br>Flash point: flammable gas | Auto-ignition temperature: 500-571°C<br>Explosive limits, vol% in air: 4-76% |
| **ENVIRONMENTAL DATA** | | |

**NOTES**

Addition of small amounts of a flammable substance or an increase in the oxygen content of the air strongly enhances combustibility. High concentrations in the air cause a deficiency of oxygen with the risk of unconsciousness or death. Check oxygen content before entering area. No odour warning if toxic concentrations are present. Measure hydrogen concentrations with suitable gas detector (a normal flammable gas detector is not suited for the purpose). After use for welding, turn valve off; regularly check tubing, etc., and test for leaks with soap and water. The measures mentioned in section PREVENTION are applicable to production, filling of cylinders, and storage of the gas.
Transport Emergency Card: TEC (R)-20
NFPA Code: H0; F4; R0;

# International Chemical Safety Cards

## CARBON MONOXIDE

ICSC: 0023

CARBON MONOXIDE
Carbon oxide
Carbonic oxide
(cylinder)
CO
Molecular mass: 28.0

CAS # 630-08-0
RTECS # FG3500000
ICSC # 0023
UN # 1016
EC # 006-001-00-2

| TYPES OF HAZARD/ EXPOSURE | ACUTE HAZARDS/ SYMPTOMS | PREVENTION | FIRST AID/ FIRE FIGHTING |
|---|---|---|---|
| FIRE | Extremely flammable. | NO open flames, NO sparks, and NO smoking. | Shut off supply; if not possible and no risk to surroundings, let the fire burn itself out; in other cases extinguish with carbon dioxide, water spray, powder. |
| EXPLOSION | Gas/air mixtures are explosive. | Closed system, ventilation, explosion-proof electrical equipment and lighting. Use non-sparking handtools. | In case of fire: keep cylinder cool by spraying with water. Combat fire from a sheltered position. |
| EXPOSURE | | AVOID EXPOSURE OF (PREGNANT) WOMEN! | IN ALL CASES CONSULT A DOCTOR! |
| INHALATION | Confusion. Dizziness. Headache. Nausea. Unconsciousness. Weakness. | Ventilation, local exhaust, or breathing protection. | Fresh air, rest. Artificial respiration if indicated. Refer for medical attention. |
| SKIN | | | |
| EYES | | | |
| INGESTION | | | |

| SPILLAGE DISPOSAL | STORAGE | PACKAGING & LABELLING |
|---|---|---|
| Evacuate danger area! Consult an expert! Ventilation (extra personal protection: self-contained breathing apparatus). | Fireproof. Cool. | F+ symbol<br>T symbol<br>R: 61-12-23-48/23<br>S: 53-45<br>Note: E<br>UN Hazard Class: 2.3<br>UN Subsidiary Risks: 2.1 |

**SEE IMPORTANT INFORMATION ON BACK**

**ICSC: 0023**

# International Chemical Safety Cards

## CARBON MONOXIDE

**ICSC: 0023**

### IMPORTANT DATA

**PHYSICAL STATE; APPEARANCE:**
ODOURLESS, TASTELESS, COLOURLESS COMPRESSED GAS.

**PHYSICAL DANGERS:**
The gas mixes well with air, explosive mixtures are easily formed. The gas penetrates easily through walls and ceilings.

**CHEMICAL DANGERS:**
In the presence of finely dispersed metal powders the substance forms toxic and flammable carbonyls. May react vigorously with oxygen, acetylene, chlorine, fluorine, nitrous oxide.

**OCCUPATIONAL EXPOSURE LIMITS (OELs):**
TLV: 25 ppm; 29 mg/m$^3$ (as TWA) (ACGIH 1994-1995).
MAK: 30 ppm; 33 mg/m$^3$; Pregnancy: B (harmful effect probable in spite of observance of MAK) (1993).

**ROUTES OF EXPOSURE:**
The substance can be absorbed into the body by inhalation.

**INHALATION RISK:**
A harmful concentration of this gas in the air will be reached very quickly on loss of containment.

**EFFECTS OF SHORT-TERM EXPOSURE:**
The substance may cause effects on the blood, cardiovascular system and central nervous system. Exposure at high levels may result in lowering of consciousness and death. Medical observation is indicated.

**EFFECTS OF LONG-TERM OR REPEATED EXPOSURE:**
The substance may have effects on the nervous system and the cardiovascular system , resulting in neurological and cardiac disorders). Suspected to cause reproductive effects such as neurological problems, low birth weight, increased still births, and congenital heart problems.

### PHYSICAL PROPERTIES

Boiling point: -191°C
Melting point: -205°C
Solubility in water, ml/100 ml at 20°C: 2.3
Relative vapour density (air = 1): 0.97

Flash point: Flammable Gas
Auto-ignition temperature: 605°C
Explosive limits, vol% in air: 12.5-74.2

### ENVIRONMENTAL DATA

### N O T E S

Carbon monoxide is a product of incomplete combustion of coal, oil, wood. It is present in vehicle exhaust and tobacco smoke. Depending on the degree of exposure, periodic medical examination is indicated. No odour warning if toxic concentrations are present.
Transport Emergency Card: TEC (R)-827
NFPA Code: H3; F4; R0

# International Chemical Safety Cards

## METHANOL

**ICSC: 0057**

METHANOL
Methyl alcohol
Carbinol
Wood alcohol
$CH_4O/CH_3OH$
Molecular mass: 32.0

CAS # 67-56-1
RTECS # PC1400000
ICSC # 0057
UN # 1230
EC # 603-001-00-X

| TYPES OF HAZARD/ EXPOSURE | ACUTE HAZARDS/ SYMPTOMS | PREVENTION | FIRST AID/ FIRE FIGHTING |
|---|---|---|---|
| **FIRE** | Highly flammable. | NO open flames, NO sparks, and NO smoking. NO contact with oxidants. | Powder, alcohol-resistant foam, water in large amounts, carbon dioxide. |
| **EXPLOSION** | Vapour/air mixtures are explosive. | Closed system, ventilation, explosion-proof electrical equipment and lighting. Do NOT use compressed air for filling, discharging, or handling. Use non-sparking handtools. | In case of fire: keep drums, etc., cool by spraying with water. |
| **EXPOSURE** | | AVOID EXPOSURE OF ADOLESCENTS AND CHILDREN! | |
| **INHALATION** | Cough. Dizziness. Headache. Nausea. | Ventilation. Local exhaust or breathing protection. | Fresh air, rest. Refer for medical attention. |
| **SKIN** | MAY BE ABSORBED! Dry skin. Redness. | Protective gloves. Protective clothing. | Remove contaminated clothes. Rinse skin with plenty of water or shower. Refer for medical attention. |
| **EYES** | Redness. Pain. | Safety goggles or eye protection in combination with breathing protection. | First rinse with plenty of water for several minutes (remove contact lenses if easily possible), then take to a doctor. |
| **INGESTION** | Abdominal pain. Shortness of breath. Unconsciousness. Vomiting (further see Inhalation). | Do not eat, drink, or smoke during work. | Induce vomiting (ONLY IN CONSCIOUS PERSONS!). Refer for medical attention. |

| SPILLAGE DISPOSAL | STORAGE | PACKAGING & LABELLING |
|---|---|---|
| Evacuate danger area! Collect leaking liquid in sealable containers. Wash away spilled liquid with plenty of water. Remove vapour with fine water spray (extra personal protection: complete protective clothing including self-contained breathing | Fireproof. Separated from strong oxidants, food and feedstuffs. Cool. | Do not transport with food and feedstuffs.<br>F symbol<br>T symbol<br>R: 11-23/25<br>S: (1/2-)7-16-24-25 |

apparatus).

UN Hazard Class: 3
UN Subsidiary Risks: 6.1
UN Packing Group: II

**SEE IMPORTANT INFORMATION ON BACK**

**ICSC: 0057** Prepared in the context of cooperation between the International Programme on Chemical Safety & the Commission of the European Communities © IPCS CEC 1993

# International Chemical Safety Cards

## METHANOL

**ICSC: 0057**

| | | |
|---|---|---|
| **I M P O R T A N T D A T A** | **PHYSICAL STATE; APPEARANCE:** COLOURLESS LIQUID , WITH CHARACTERISTIC ODOUR.<br><br>**PHYSICAL DANGERS:** The vapour mixes well with air, explosive mixtures are easily formed.<br><br>**CHEMICAL DANGERS:** Reacts violently with oxidants causing fire and explosion hazard.<br><br>**OCCUPATIONAL EXPOSURE LIMITS (OELs):** TLV: 200 ppm; 262 mg/m$^3$ as TWA (skin) (ACGIH 1991-1992). TLV (as STEL): 250 ppm; 328 mg/m$^3$ (skin) (ACGIH 1992-1993). | **ROUTES OF EXPOSURE:** The substance can be absorbed into the body by inhalation and through the skin, and by ingestion.<br><br>**INHALATION RISK:** A harmful contamination of the air can be reached rather quickly on evaporation of this substance at 20°C.<br><br>**EFFECTS OF SHORT-TERM EXPOSURE:** The substance irritates the eyes, the skin and the respiratory tract. The substance may cause effects on the central nervous system , resulting in loss of consciousness. Exposure by ingestion may result in blindness and death. The effects may be delayed. Medical observation is indicated.<br><br>**EFFECTS OF LONG-TERM OR REPEATED EXPOSURE:** Repeated or prolonged contact with skin may cause dermatitis. The substance may have effects on the central nervous system , resulting in persistant or recurring headaches and impaired vision. |
| **PHYSICAL PROPERTIES** | Boiling point: 65°C<br>Melting point: -98°C<br>Relative density (water = 1): 0.79<br>Solubility in water: miscible<br>Vapour pressure, kPa at 20°C: 12.3<br>Relative vapour density (air = 1): 1.1 | Relative density of the vapour/air-mixture at 20°C (air = 1): 1.01<br>Flash point: 12°C c.c.<br>Auto-ignition temperature: 385°C<br>Explosive limits, vol% in air: 6-35.6<br>Octanol/water partition coefficient as log Pow: -0.82/-0.66 |
| **ENVIRONMENTAL DATA** | Effects: The substance is of low toxicity to aquatic and terrestrial organisms. | |

**N O T E S**

Burns with nonluminous bluish flame. Depending on the degree of exposure, periodic medical examination is indicated.
Transport Emergency Card: TEC (R)-36
NFPA Code: H 1; F 3; R 0;

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# APPENDIX G Riskplot Output File

Due to the size of the output file from Risk Plot II, it is available upon request, if not included with this report.

Riskplot II v2.10
GTL PRA 200302 UPDATE

Weather probabilities

Time period: Day

| | 1.8F | 2.5B | 3.0F | 4.2C | 5.1D | 6.3C |
|---|---|---|---|---|---|---|
| N | 0 | .01678082 | 0 | .02420091 | 0 | .02922374 |
| NE | 0 | .00616438 | 0 | .01815068 | 0 | .02842466 |
| E | 0 | .02123288 | 0 | .04292237 | 0 | .03424658 |
| SE | 0 | .03390411 | 0 | .02888128 | 0 | .0076484 |
| S | 0 | .02020548 | 0 | .00684932 | 0 | .00136986 |
| SW | 0 | .03413242 | 0 | .00947489 | 0 | .00216895 |
| W | 0 | .0206621 | 0 | .02956621 | 0 | .0423516 |
| NW | 0 | .01518265 | 0 | .0130137 | 0 | .01324201 |

Time period: Night

| | 1.8F | 2.5B | 3.0F | 4.2C | 5.1D | 6.3C |
|---|---|---|---|---|---|---|
| N | .00707763 | 0 | .00730594 | 0 | .01883562 | 0 |
| NE | .00833333 | 0 | .01050228 | 0 | .01221461 | 0 |
| E | .01792237 | 0 | .01267123 | 0 | .00422374 | 0 |
| SE | .02922374 | 0 | .0336758 | 0 | .01666667 | 0 |
| S | .0336758 | 0 | .01906393 | 0 | .00810502 | 0 |
| SW | .04611872 | 0 | .04657534 | 0 | .03013699 | 0 |
| W | .0109589 | 0 | .02363014 | 0 | .06940639 | 0 |
| NW | .00650685 | 0 | .00856164 | 0 | .01860731 | 0 |

Populations

Population: Burrup Fertiliser Site (Area, static)

Coordinates:

| | |
|---|---|
| 76458 | 19667 |
| 77167 | 19583 |
| 77250 | 18542 |
| 76583 | 18583 |

| Day | Night |
|---|---|
| 40 | 10 |

Population: Plenty River Site (Area, static)

Coordinates:

| | |
|---|---|
| 76417 | 19447 |
| 76479 | 18625 |
| 75750 | 18604 |
| 75708 | 19125 |
| 75833 | 19458 |

| Day | Night |
|---|---|
| 40 | 10 |

Population: Woodside OTP (Area, static)

Coordinates:

| | |
|---|---|
| 75416 | 23208 |
| 76458 | 23208 |
| 76600 | 22292 |
| 76292 | 22000 |
| 73042 | 22000 |
| 74917 | 22292 |
| 75416 | 23208 |

| Day | Night |
|---|---|
| 100 | 15 |

Areas of significant topography

Consequences

Consequence: Iso 1 BLEVE Man ru (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 89 | 89 | -89 | 0 |
| .5 | 155 | 155 | -155 | 0 |
| .1 | 271 | 271 | -271 | 0 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 86 | 86 | -86 | 0 |
| .5 | 150 | 150 | -150 | 0 |
| .1 | 259 | 259 | -259 | 0 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 89 | 89 | -89 | 0 |
| .5 | 155 | 155 | -155 | 0 |
| .1 | 271 | 271 | -271 | 0 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 86 | 86 | -86 | 0 |
| .5 | 150 | 150 | -150 | 0 |
| .1 | 259 | 259 | -259 | 0 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 89 | 89 | -89 | 0 |
| .5 | 155 | 155 | -155 | 0 |
| .1 | 271 | 271 | -271 | 0 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 86 | 86 | -86 | 0 |
| .5 | 150 | 150 | -150 | 0 |
| .1 | 259 | 259 | -259 | 0 |

Consequence: Iso 1 BLEVE No ru (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 63 | 63 | -63 | 0 |
| .5 | 110 | 110 | -110 | 0 |

| | | | | |
|---|---|---|---|---|
| .1 | 192 | 192 | -192 | 0 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 61 | 61 | -61 | 0 |
| .5 | 106 | 106 | -106 | 0 |
| .1 | 185 | 185 | -185 | 0 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 63 | 63 | -63 | 0 |
| .5 | 110 | 110 | -110 | 0 |
| .1 | 192 | 192 | -192 | 0 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 61 | 61 | -61 | 0 |
| .5 | 106 | 106 | -106 | 0 |
| .1 | 185 | 185 | -185 | 0 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 63 | 63 | -63 | 0 |
| .5 | 110 | 110 | -110 | 0 |
| .1 | 192 | 192 | -192 | 0 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 61 | 61 | -61 | 0 |
| .5 | 106 | 106 | -106 | 0 |
| .1 | 185 | 185 | -185 | 0 |

Consequence: Iso 1 jetfi Man 22 (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 17 | 0 | 1 | 9 |
| .5 | 18 | 6 | 0 | 9 |
| .1 | 19 | 13 | -1 | 9 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 17 | 0 | 1 | 9 |
| .5 | 18 | 6 | 0 | 9 |
| .1 | 19 | 13 | -1 | 9 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 17 | 0 | 1 | 9 |
| .5 | 18 | 6 | 0 | 9 |
| .1 | 19 | 13 | -1 | 9 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 17 | 0 | 1 | 9 |
| .5 | 18 | 6 | 0 | 9 |
| .1 | 19 | 13 | -1 | 9 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 17 | 0 | 1 | 9 |
| .5 | 18 | 6 | 0 | 9 |
| .1 | 19 | 13 | -1 | 9 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 17 | 0 | 1 | 9 |
| .5 | 18 | 6 | 0 | 9 |
| .1 | 19 | 13 | -1 | 9 |

Consequence: Iso 1 jetfi Man 70 (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 53 | 3 | 2 | 27 |
| .5 | 54 | 20 | 0 | 26 |
| .1 | 59 | 41 | -3 | 27 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 53 | 3 | 2 | 27 |
| .5 | 54 | 20 | 0 | 27 |
| .1 | 58 | 40 | -3 | 27 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 53 | 3 | 2 | 27 |
| .5 | 54 | 20 | 0 | 26 |
| .1 | 59 | 41 | -3 | 27 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 53 | 3 | 2 | 27 |
| .5 | 54 | 20 | 0 | 27 |
| .1 | 58 | 40 | -3 | 27 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 53 | 3 | 2 | 27 |
| .5 | 54 | 20 | 0 | 26 |
| .1 | 59 | 41 | -3 | 27 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 53 | 3 | 2 | 27 |
| .5 | 54 | 20 | 0 | 27 |
| .1 | 58 | 40 | -3 | 27 |

Consequence: Iso 1 jetfi Man 7m (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| .5 | 5 | 1 | 0 | 3 |
| .1 | 6 | 4 | 0 | 3 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| .5 | 5 | 1 | 0 | 3 |
| .1 | 6 | 4 | 0 | 3 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| .5 | 5 | 1 | 0 | 3 |
| .1 | 6 | 4 | 0 | 3 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| .5 | 5 | 1 | 0 | 3 |
| .1 | 6 | 4 | 0 | 3 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| .5 | 5 | 1 | 0 | 3 |
| .1 | 6 | 4 | 0 | 3 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| .5 | 5 | 1 | 0 | 3 |
| .1 | 6 | 4 | 0 | 3 |

Consequence: Iso 1 jetfi Man ru (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 145 | 8 | 2 | 73 |
| .5 | 148 | 56 | -1 | 73 |
| .1 | 161 | 113 | -9 | 75 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 145 | 8 | 2 | 74 |
| .5 | 148 | 54 | -1 | 73 |
| .1 | 160 | 108 | -8 | 76 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 145 | 8 | 2 | 73 |
| .5 | 148 | 56 | -1 | 73 |
| .1 | 161 | 113 | -9 | 75 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 145 | 8 | 2 | 74 |
| .5 | 148 | 54 | -1 | 73 |
| .1 | 160 | 108 | -8 | 76 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 145 | 8 | 2 | 73 |
| .5 | 148 | 56 | -1 | 73 |
| .1 | 161 | 113 | -9 | 75 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 145 | 8 | 2 | 74 |
| .5 | 148 | 54 | -1 | 73 |
| .1 | 160 | 108 | -8 | 76 |

Consequence: Iso 1 jetfi No 22 (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 17 | 0 | 1 | 9 |
| .5 | 18 | 6 | 0 | 9 |
| .1 | 19 | 13 | -1 | 9 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 17 | 0 | 1 | 9 |
| .5 | 18 | 6 | 0 | 9 |
| .1 | 19 | 13 | -1 | 9 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 17 | 0 | 1 | 9 |
| .5 | 18 | 6 | 0 | 9 |
| .1 | 19 | 13 | -1 | 9 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 17 | 0 | 1 | 9 |
| .5 | 18 | 6 | 0 | 9 |
| .1 | 19 | 13 | -1 | 9 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 17 | 0 | 1 | 9 |
| .5 | 18 | 6 | 0 | 9 |
| .1 | 19 | 13 | -1 | 9 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|

| | | | | |
|---|---|---|---|---|
| 1 | 17 | 0 | 1 | 9 |
| .5 | 18 | 6 | 0 | 9 |
| .1 | 19 | 13 | -1 | 9 |

Consequence: Iso 1 jetfi No 70 (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 53 | 3 | 2 | 27 |
| .5 | 54 | 20 | 0 | 26 |
| .1 | 59 | 41 | -3 | 27 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 53 | 3 | 2 | 27 |
| .5 | 54 | 20 | 0 | 27 |
| .1 | 58 | 40 | -3 | 27 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 53 | 3 | 2 | 27 |
| .5 | 54 | 20 | 0 | 26 |
| .1 | 59 | 41 | -3 | 27 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 53 | 3 | 2 | 27 |
| .5 | 54 | 20 | 0 | 27 |
| .1 | 58 | 40 | -3 | 27 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 53 | 3 | 2 | 27 |
| .5 | 54 | 20 | 0 | 26 |
| .1 | 59 | 41 | -3 | 27 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 53 | 3 | 2 | 27 |
| .5 | 54 | 20 | 0 | 27 |
| .1 | 58 | 40 | -3 | 27 |

Consequence: Iso 1 jetfi No 7m (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| .5 | 5 | 1 | 0 | 3 |
| .1 | 6 | 4 | 0 | 3 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| .5 | 5 | 1 | 0 | 3 |
| .1 | 6 | 4 | 0 | 3 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| .5 | 5 | 1 | 0 | 3 |
| .1 | 6 | 4 | 0 | 3 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| .5 | 5 | 1 | 0 | 3 |
| .1 | 6 | 4 | 0 | 3 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| .5 | 5 | 1 | 0 | 3 |
| .1 | 6 | 4 | 0 | 3 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| .5 | 5 | 1 | 0 | 3 |
| .1 | 6 | 4 | 0 | 3 |

Consequence: Iso 1 jetfi No ru (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 145 | 8 | 2 | 73 |
| .5 | 148 | 56 | -1 | 73 |
| .1 | 161 | 113 | -9 | 75 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 145 | 8 | 2 | 74 |
| .5 | 148 | 54 | -1 | 73 |
| .1 | 160 | 108 | -8 | 76 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 145 | 8 | 2 | 73 |
| .5 | 148 | 56 | -1 | 73 |
| .1 | 161 | 113 | -9 | 75 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 145 | 8 | 2 | 74 |
| .5 | 148 | 54 | -1 | 73 |
| .1 | 160 | 108 | -8 | 76 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 145 | 8 | 2 | 73 |
| .5 | 148 | 56 | -1 | 73 |
| .1 | 161 | 113 | -9 | 75 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 145 | 8 | 2 | 74 |
| .5 | 148 | 54 | -1 | 73 |
| .1 | 160 | 108 | -8 | 76 |

Consequence: Iso 1 late Man 70 (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 66 | 6 | 53 | 59 |
| .5 | 70 | 10 | 50 | 60 |
| .1 | 74 | 14 | 46 | 60 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 66 | 6 | 53 | 59 |
| .5 | 70 | 10 | 50 | 60 |
| .1 | 74 | 14 | 46 | 60 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 66 | 6 | 53 | 59 |
| .5 | 70 | 10 | 50 | 60 |
| .1 | 74 | 14 | 46 | 60 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 66 | 6 | 53 | 59 |
| .5 | 70 | 10 | 50 | 60 |
| .1 | 74 | 14 | 46 | 60 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 66 | 6 | 53 | 59 |
| .5 | 70 | 10 | 50 | 60 |
| .1 | 74 | 14 | 46 | 60 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 66 | 6 | 53 | 59 |
| .5 | 70 | 10 | 50 | 60 |
| .1 | 74 | 14 | 46 | 60 |

Consequence: Iso 1 late Man ru (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 172 | 22 | 128 | 150 |
| .5 | 183 | 33 | 116 | 149 |
| .1 | 196 | 46 | 104 | 150 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|

| | | | | |
|---|---|---|---|---|
| 1 | 190 | 20 | 150 | 170 |
| .5 | 199 | 29 | 141 | 170 |
| .1 | 211 | 41 | 129 | 170 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 172 | 22 | 128 | 150 |
| .5 | 183 | 33 | 116 | 149 |
| .1 | 196 | 46 | 104 | 150 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 200 | 19 | 161 | 180 |
| .5 | 210 | 29 | 151 | 180 |
| .1 | 220 | 40 | 140 | 180 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 190 | 20 | 150 | 170 |
| .5 | 199 | 29 | 141 | 170 |
| .1 | 211 | 41 | 129 | 170 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 200 | 19 | 161 | 180 |
| .5 | 210 | 29 | 151 | 180 |
| .1 | 220 | 40 | 140 | 180 |

Consequence: Iso 1 late No 70 (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 67 | 6 | 54 | 60 |
| .5 | 70 | 10 | 50 | 60 |
| .1 | 74 | 14 | 46 | 60 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 67 | 6 | 54 | 60 |
| .5 | 70 | 10 | 50 | 60 |
| .1 | 74 | 14 | 46 | 60 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 67 | 6 | 54 | 60 |
| .5 | 70 | 10 | 50 | 60 |
| .1 | 74 | 14 | 46 | 60 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 67 | 6 | 54 | 60 |
| .5 | 70 | 10 | 50 | 60 |
| .1 | 74 | 14 | 46 | 60 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 67 | 6 | 54 | 60 |
| .5 | 70 | 10 | 50 | 60 |
| .1 | 74 | 14 | 46 | 60 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 67 | 6 | 54 | 60 |
| .5 | 70 | 10 | 50 | 60 |
| .1 | 74 | 14 | 46 | 60 |

Consequence: Iso 1 late No ru (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 130 | 20 | 90 | 110 |
| .5 | 139 | 29 | 81 | 110 |
| .1 | 151 | 41 | 69 | 110 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 138 | 18 | 102 | 120 |
| .5 | 148 | 28 | 92 | 120 |
| .1 | 158 | 38 | 82 | 120 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 130 | 20 | 90 | 110 |
| .5 | 139 | 29 | 81 | 110 |
| .1 | 151 | 41 | 69 | 110 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 138 | 18 | 102 | 120 |
| .5 | 148 | 28 | 92 | 120 |
| .1 | 158 | 38 | 82 | 120 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 138 | 18 | 102 | 120 |
| .5 | 148 | 28 | 92 | 120 |
| .1 | 158 | 38 | 82 | 120 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 148 | 18 | 112 | 130 |
| .5 | 165 | 31 | 103 | 134 |
| .1 | 167 | 37 | 93 | 130 |

Consequence: Iso 10 late Man 22 (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|

| | | | | |
|---|---|---|---|---|
| 1 | 13 | 3 | 7 | 10 |
| .5 | 14 | 4 | 6 | 10 |
| .1 | 16 | 6 | 4 | 10 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 23 | 3 | 17 | 20 |
| .5 | 24 | 4 | 16 | 20 |
| .1 | 26 | 6 | 14 | 20 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 13 | 3 | 7 | 10 |
| .5 | 14 | 4 | 6 | 10 |
| .1 | 16 | 6 | 4 | 10 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 13 | 3 | 7 | 10 |
| .5 | 14 | 4 | 6 | 10 |
| .1 | 16 | 6 | 4 | 10 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 0 | 0 | 0 | 0 | 0 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 0 | 0 | 0 | 0 | 0 |

Consequence: Iso 10 late Man 70 (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 35 | 5 | 25 | 30 |
| .5 | 36 | 6 | 24 | 30 |
| .1 | 39 | 9 | 21 | 30 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 35 | 5 | 25 | 30 |
| .5 | 36 | 6 | 24 | 30 |
| .1 | 39 | 9 | 21 | 30 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 35 | 5 | 25 | 30 |
| .5 | 36 | 6 | 24 | 30 |
| .1 | 39 | 9 | 21 | 30 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|

| | | | | |
|---|---|---|---|---|
| 1 | 35 | 5 | 25 | 30 |
| .5 | 36 | 6 | 24 | 30 |
| .1 | 39 | 9 | 21 | 30 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 35 | 5 | 25 | 30 |
| .5 | 36 | 6 | 24 | 30 |
| .1 | 39 | 9 | 21 | 30 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 35 | 5 | 25 | 30 |
| .5 | 36 | 6 | 24 | 30 |
| .1 | 39 | 9 | 21 | 30 |

Consequence: Iso 10 late Man ru (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 207 | 17 | 173 | 190 |
| .5 | 215 | 25 | 165 | 190 |
| .1 | 225 | 35 | 155 | 190 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 130 | 10 | 110 | 120 |
| .5 | 137 | 17 | 103 | 120 |
| .1 | 143 | 23 | 97 | 120 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 130 | 10 | 110 | 120 |
| .5 | 137 | 17 | 103 | 120 |
| .1 | 143 | 23 | 97 | 120 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 110 | 10 | 90 | 100 |
| .5 | 117 | 17 | 83 | 100 |
| .1 | 123 | 23 | 77 | 100 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 100 | 10 | 80 | 90 |
| .5 | 105 | 15 | 75 | 90 |
| .1 | 110 | 20 | 70 | 90 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 101 | 11 | 79 | 90 |
| .5 | 107 | 17 | 73 | 90 |
| .1 | 113 | 23 | 67 | 90 |

Consequence: Iso 10 late No 22 (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 13 | 3 | 7 | 10 |
| .5 | 14 | 4 | 6 | 10 |
| .1 | 16 | 6 | 4 | 10 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 23 | 3 | 17 | 20 |
| .5 | 24 | 4 | 16 | 20 |
| .1 | 26 | 6 | 14 | 20 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 13 | 3 | 7 | 10 |
| .5 | 14 | 4 | 6 | 10 |
| .1 | 16 | 6 | 4 | 10 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 13 | 3 | 7 | 10 |
| .5 | 14 | 4 | 6 | 10 |
| .1 | 16 | 6 | 4 | 10 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 0 | 0 | 0 | 0 | 0 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 0 | 0 | 0 | 0 | 0 |

Consequence: Iso 10 late No 70 (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 35 | 5 | 25 | 30 |
| .5 | 36 | 6 | 24 | 30 |
| .1 | 39 | 9 | 21 | 30 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 35 | 5 | 25 | 30 |
| .5 | 36 | 6 | 24 | 30 |
| .1 | 39 | 9 | 21 | 30 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 35 | 5 | 25 | 30 |
| .5 | 36 | 6 | 24 | 30 |
| .1 | 39 | 9 | 21 | 30 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 35 | 5 | 25 | 30 |
| .5 | 36 | 6 | 24 | 30 |
| .1 | 39 | 9 | 21 | 30 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 35 | 5 | 25 | 30 |
| .5 | 36 | 6 | 24 | 30 |
| .1 | 39 | 9 | 21 | 30 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 35 | 5 | 25 | 30 |
| .5 | 36 | 6 | 24 | 30 |
| .1 | 39 | 9 | 21 | 30 |

Consequence: Iso 10 late No ru (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 207 | 17 | 173 | 190 |
| .5 | 215 | 25 | 165 | 190 |
| .1 | 225 | 35 | 155 | 190 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 130 | 10 | 110 | 120 |
| .5 | 137 | 17 | 103 | 120 |
| .1 | 143 | 23 | 97 | 120 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 130 | 10 | 110 | 120 |
| .5 | 137 | 17 | 103 | 120 |
| .1 | 143 | 23 | 97 | 120 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 110 | 10 | 90 | 100 |
| .5 | 117 | 17 | 83 | 100 |
| .1 | 123 | 23 | 77 | 100 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 100 | 10 | 80 | 90 |
| .5 | 105 | 15 | 75 | 90 |
| .1 | 110 | 20 | 70 | 90 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|

| | | | | |
|---|---|---|---|---|
| 1 | 101 | 11 | 79 | 90 |
| .5 | 107 | 17 | 73 | 90 |
| .1 | 113 | 23 | 67 | 90 |

Consequence: Iso 10 poolf Man 22 (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 37 | 24 | -13 | 11 |
| .5 | 53 | 40 | -28 | 12 |
| .1 | 79 | 66 | -55 | 12 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 38 | 24 | -12 | 12 |
| .5 | 53 | 39 | -26 | 13 |
| .1 | 78 | 64 | -52 | 13 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 38 | 24 | -12 | 12 |
| .5 | 53 | 39 | -26 | 13 |
| .1 | 78 | 64 | -51 | 13 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 39 | 23 | -11 | 13 |
| .5 | 53 | 38 | -24 | 14 |
| .1 | 77 | 61 | -47 | 14 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 39 | 23 | -12 | 13 |
| .5 | 52 | 37 | -24 | 14 |
| .1 | 74 | 60 | -46 | 14 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 40 | 22 | -10 | 15 |
| .5 | 53 | 36 | -21 | 15 |
| .1 | 75 | 58 | -44 | 15 |

Consequence: Iso 10 poolf Man 70 (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 40 | 24 | -10 | 14 |
| .5 | 56 | 40 | -25 | 15 |
| .1 | 81 | 66 | -52 | 14 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 41 | 24 | -8 | 16 |
| .5 | 57 | 39 | -22 | 17 |
| .1 | 82 | 64 | -48 | 16 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 41 | 24 | -9 | 15 |
| .5 | 56 | 39 | -22 | 16 |
| .1 | 80 | 64 | -48 | 16 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 42 | 23 | -8 | 16 |
| .5 | 56 | 38 | -21 | 17 |
| .1 | 79 | 61 | -44 | 17 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 43 | 23 | -7 | 17 |
| .5 | 56 | 37 | -19 | 18 |
| .1 | 79 | 60 | -42 | 18 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 42 | 22 | -8 | 16 |
| .5 | 55 | 36 | -20 | 17 |
| .1 | 76 | 58 | -42 | 17 |

Consequence: Iso 10 poolf Man 7m (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 20 | 12 | -5 | 7 |
| .5 | 29 | 21 | -13 | 7 |
| .1 | 43 | 35 | -28 | 7 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 19 | 11 | -3 | 7 |
| .5 | 27 | 18 | -10 | 8 |
| .1 | 39 | 31 | -22 | 8 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 21 | 12 | -5 | 7 |
| .5 | 29 | 20 | -12 | 8 |
| .1 | 42 | 33 | -25 | 8 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 20 | 10 | -3 | 8 |
| .5 | 27 | 17 | -8 | 9 |
| .1 | 38 | 28 | -19 | 9 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|

| | | | | |
|---|---|---|---|---|
| 1 | 22 | 11 | -3 | 9 |
| .5 | 29 | 18 | -9 | 9 |
| .1 | 41 | 30 | -21 | 9 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 21 | 9 | -1 | 9 |
| .5 | 27 | 16 | -7 | 10 |
| .1 | 37 | 26 | -17 | 10 |

Consequence: Iso 10 poolf Man ru (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 289 | 254 | -222 | 33 |
| .5 | 409 | 375 | -342 | 33 |
| .1 | 614 | 579 | -544 | 34 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 277 | 239 | -205 | 36 |
| .5 | 388 | 351 | -317 | 35 |
| .1 | 573 | 540 | -508 | 32 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 292 | 252 | -216 | 38 |
| .5 | 411 | 369 | -329 | 40 |
| .1 | 608 | 570 | -529 | 39 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 282 | 235 | -196 | 43 |
| .5 | 391 | 344 | -301 | 44 |
| .1 | 567 | 525 | -483 | 42 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 298 | 246 | -203 | 47 |
| .5 | 409 | 357 | -308 | 50 |
| .1 | 598 | 547 | -499 | 49 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 289 | 230 | -185 | 52 |
| .5 | 389 | 334 | -282 | 53 |
| .1 | 563 | 506 | -452 | 55 |

Consequence: Iso 10 poolf No 22 (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 37 | 24 | -13 | 11 |
| .5 | 53 | 40 | -28 | 12 |
| .1 | 79 | 66 | -55 | 12 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 38 | 24 | -12 | 12 |
| .5 | 53 | 39 | -26 | 13 |
| .1 | 78 | 64 | -52 | 13 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 38 | 24 | -12 | 12 |
| .5 | 53 | 39 | -26 | 13 |
| .1 | 78 | 64 | -51 | 13 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 39 | 23 | -11 | 13 |
| .5 | 53 | 38 | -24 | 14 |
| .1 | 77 | 61 | -47 | 14 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 39 | 23 | -12 | 13 |
| .5 | 52 | 37 | -24 | 14 |
| .1 | 74 | 60 | -46 | 14 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 38 | 24 | -12 | 12 |
| .5 | 53 | 39 | -26 | 13 |
| .1 | 78 | 64 | -52 | 13 |

Consequence: Iso 10 poolf No 70 (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 40 | 24 | -10 | 14 |
| .5 | 56 | 40 | -25 | 15 |
| .1 | 81 | 66 | -52 | 14 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 41 | 24 | -8 | 16 |
| .5 | 57 | 39 | -22 | 17 |
| .1 | 82 | 64 | -48 | 16 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 41 | 24 | -9 | 15 |
| .5 | 56 | 39 | -22 | 16 |
| .1 | 80 | 64 | -48 | 16 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|

| | | | | |
|---|---|---|---|---|
| 1 | 42 | 23 | -8 | 16 |
| .5 | 56 | 38 | -21 | 17 |
| .1 | 79 | 61 | -44 | 17 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 43 | 23 | -7 | 17 |
| .5 | 56 | 37 | -19 | 18 |
| .1 | 79 | 60 | -42 | 18 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 41 | 24 | -8 | 16 |
| .5 | 57 | 39 | -22 | 17 |
| .1 | 82 | 64 | -48 | 16 |

Consequence: Iso 10 poolf No 7m (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 20 | 12 | -5 | 7 |
| .5 | 29 | 21 | -13 | 7 |
| .1 | 43 | 35 | -28 | 7 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 19 | 11 | -3 | 7 |
| .5 | 27 | 18 | -10 | 8 |
| .1 | 39 | 31 | -22 | 8 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 21 | 12 | -5 | 7 |
| .5 | 29 | 20 | -12 | 8 |
| .1 | 42 | 33 | -25 | 8 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 20 | 10 | -3 | 8 |
| .5 | 27 | 17 | -8 | 9 |
| .1 | 38 | 28 | -19 | 9 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 22 | 11 | -3 | 9 |
| .5 | 29 | 18 | -9 | 9 |
| .1 | 41 | 30 | -21 | 9 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 19 | 11 | -3 | 7 |
| .5 | 27 | 18 | -10 | 8 |
| .1 | 39 | 31 | -22 | 8 |

Consequence: Iso 10 poolf No ru (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 289 | 254 | -222 | 33 |
| .5 | 409 | 375 | -341 | 33 |
| .1 | 614 | 579 | -544 | 34 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 277 | 239 | -204 | 36 |
| .5 | 388 | 351 | -317 | 35 |
| .1 | 572 | 540 | -508 | 32 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 292 | 252 | -215 | 38 |
| .5 | 411 | 368 | -329 | 40 |
| .1 | 608 | 569 | -528 | 39 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 282 | 235 | -196 | 43 |
| .5 | 390 | 344 | -300 | 44 |
| .1 | 567 | 525 | -483 | 42 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 298 | 246 | -202 | 47 |
| .5 | 408 | 356 | -308 | 50 |
| .1 | 597 | 546 | -498 | 49 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 277 | 239 | -204 | 36 |
| .5 | 388 | 351 | -317 | 35 |
| .1 | 572 | 540 | -508 | 32 |

Consequence: Iso 11 BLEVE No ru (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 0 | 0 | 0 | 0 |
| .5 | 0 | 0 | 0 | 0 |
| .1 | 0 | 0 | 0 | 0 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 0 | 0 | 0 | 0 |
| .5 | 0 | 0 | 0 | 0 |
| .1 | 0 | 0 | 0 | 0 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|

| | | | | |
|---|---|---|---|---|
| 1 | 0 | 0 | 0 | 0 |
| .5 | 0 | 0 | 0 | 0 |
| .1 | 0 | 0 | 0 | 0 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 0 | 0 | 0 | 0 |
| .5 | 0 | 0 | 0 | 0 |
| .1 | 0 | 0 | 0 | 0 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 0 | 0 | 0 | 0 |
| .5 | 0 | 0 | 0 | 0 |
| .1 | 0 | 0 | 0 | 0 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 0 | 0 | 0 | 0 |
| .5 | 0 | 0 | 0 | 0 |
| .1 | 0 | 0 | 0 | 0 |

Consequence: Iso 11 late Man 70 (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 24 | 4 | 16 | 20 |
| .5 | 26 | 6 | 14 | 20 |
| .1 | 28 | 8 | 12 | 20 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 24 | 4 | 16 | 20 |
| .5 | 26 | 6 | 14 | 20 |
| .1 | 28 | 8 | 12 | 20 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 24 | 4 | 16 | 20 |
| .5 | 26 | 6 | 14 | 20 |
| .1 | 28 | 8 | 12 | 20 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 24 | 4 | 16 | 20 |
| .5 | 26 | 6 | 14 | 20 |
| .1 | 28 | 8 | 12 | 20 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 24 | 4 | 16 | 20 |
| .5 | 26 | 6 | 14 | 20 |
| .1 | 28 | 8 | 12 | 20 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 24 | 4 | 16 | 20 |
| .5 | 26 | 6 | 14 | 20 |
| .1 | 28 | 8 | 12 | 20 |

Consequence: Iso 11 late Man ru (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 47 | 7 | 33 | 40 |
| .5 | 52 | 12 | 28 | 40 |
| .1 | 55 | 15 | 25 | 40 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 58 | 8 | 42 | 50 |
| .5 | 62 | 12 | 38 | 50 |
| .1 | 66 | 16 | 34 | 50 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 47 | 7 | 33 | 40 |
| .5 | 52 | 12 | 28 | 40 |
| .1 | 55 | 15 | 25 | 40 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 58 | 8 | 42 | 50 |
| .5 | 62 | 12 | 38 | 50 |
| .1 | 66 | 16 | 34 | 50 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 58 | 8 | 42 | 50 |
| .5 | 62 | 12 | 38 | 50 |
| .1 | 66 | 16 | 34 | 50 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 68 | 8 | 52 | 60 |
| .5 | 72 | 12 | 48 | 60 |
| .1 | 77 | 17 | 43 | 60 |

Consequence: Iso 11 late No 70 (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 24 | 4 | 16 | 20 |
| .5 | 26 | 6 | 14 | 20 |
| .1 | 28 | 8 | 12 | 20 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|

| | | | | |
|---|---|---|---|---|
| 1 | 24 | 4 | 16 | 20 |
| .5 | 26 | 6 | 14 | 20 |
| .1 | 28 | 8 | 12 | 20 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 24 | 4 | 16 | 20 |
| .5 | 26 | 6 | 14 | 20 |
| .1 | 28 | 8 | 12 | 20 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 24 | 4 | 16 | 20 |
| .5 | 26 | 6 | 14 | 20 |
| .1 | 28 | 8 | 12 | 20 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 24 | 4 | 16 | 20 |
| .5 | 26 | 6 | 14 | 20 |
| .1 | 28 | 8 | 12 | 20 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 24 | 4 | 16 | 20 |
| .5 | 26 | 6 | 14 | 20 |
| .1 | 28 | 8 | 12 | 20 |

Consequence: Iso 11 late No ru (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 47 | 7 | 33 | 40 |
| .5 | 52 | 12 | 28 | 40 |
| .1 | 55 | 15 | 25 | 40 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 58 | 8 | 42 | 50 |
| .5 | 62 | 12 | 38 | 50 |
| .1 | 66 | 16 | 34 | 50 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 47 | 7 | 33 | 40 |
| .5 | 52 | 12 | 28 | 40 |
| .1 | 55 | 15 | 25 | 40 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 58 | 8 | 42 | 50 |
| .5 | 62 | 12 | 38 | 50 |
| .1 | 66 | 16 | 34 | 50 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 58 | 8 | 42 | 50 |
| .5 | 62 | 12 | 38 | 50 |
| .1 | 66 | 16 | 34 | 50 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 68 | 8 | 52 | 60 |
| .5 | 72 | 12 | 48 | 60 |
| .1 | 77 | 17 | 43 | 60 |

Consequence: Iso 11 poolf Man 22 (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 36 | 24 | -14 | 10 |
| .5 | 52 | 40 | -29 | 11 |
| .1 | 77 | 66 | -56 | 10 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 36 | 23 | -12 | 12 |
| .5 | 51 | 38 | -26 | 12 |
| .1 | 76 | 62 | -50 | 12 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 37 | 24 | -13 | 11 |
| .5 | 52 | 39 | -26 | 12 |
| .1 | 76 | 64 | -52 | 12 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 38 | 22 | -11 | 13 |
| .5 | 51 | 36 | -23 | 14 |
| .1 | 74 | 59 | -45 | 14 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 38 | 23 | -11 | 13 |
| .5 | 52 | 37 | -23 | 14 |
| .1 | 74 | 60 | -46 | 13 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 38 | 21 | -10 | 14 |
| .5 | 51 | 35 | -21 | 14 |
| .1 | 71 | 56 | -42 | 14 |

Consequence: Iso 11 poolf Man 70 (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|

| | | | | |
|---|---|---|---|---|
| 1 | 38 | 24 | -12 | 12 |
| .5 | 54 | 40 | -27 | 13 |
| .1 | 80 | 66 | -53 | 13 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 39 | 24 | -10 | 14 |
| .5 | 55 | 39 | -24 | 15 |
| .1 | 80 | 64 | -50 | 15 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 39 | 24 | -11 | 14 |
| .5 | 54 | 39 | -24 | 15 |
| .1 | 79 | 64 | -49 | 14 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 41 | 23 | -9 | 15 |
| .5 | 54 | 38 | -22 | 16 |
| .1 | 78 | 61 | -46 | 16 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 42 | 23 | -9 | 16 |
| .5 | 55 | 37 | -21 | 16 |
| .1 | 78 | 60 | -43 | 17 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 42 | 22 | -9 | 16 |
| .5 | 54 | 36 | -20 | 17 |
| .1 | 76 | 58 | -42 | 17 |

Consequence: Iso 11 poolf Man 7m (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 20 | 12 | -5 | 7 |
| .5 | 28 | 20 | -13 | 7 |
| .1 | 42 | 34 | -26 | 7 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 18 | 10 | -4 | 7 |
| .5 | 25 | 17 | -10 | 7 |
| .1 | 37 | 29 | -22 | 7 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 20 | 11 | -4 | 7 |
| .5 | 28 | 19 | -11 | 8 |
| .1 | 40 | 32 | -24 | 8 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 19 | 10 | -3 | 8 |
| .5 | 25 | 16 | -8 | 8 |
| .1 | 36 | 27 | -19 | 8 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 21 | 11 | -3 | 8 |
| .5 | 27 | 18 | -9 | 9 |
| .1 | 39 | 29 | -20 | 9 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 20 | 9 | -2 | 9 |
| .5 | 26 | 15 | -7 | 9 |
| .1 | 35 | 25 | -16 | 9 |

Consequence: Iso 11 poolf Man ru (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 45 | 26 | -8 | 18 |
| .5 | 62 | 43 | -24 | 18 |
| .1 | 90 | 71 | -53 | 18 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 44 | 24 | -6 | 18 |
| .5 | 59 | 39 | -20 | 19 |
| .1 | 84 | 64 | -46 | 18 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 43 | 24 | -7 | 18 |
| .5 | 58 | 39 | -20 | 19 |
| .1 | 83 | 64 | -45 | 18 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 48 | 25 | -6 | 21 |
| .5 | 63 | 40 | -19 | 22 |
| .1 | 88 | 66 | -44 | 21 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 48 | 25 | -6 | 21 |
| .5 | 63 | 40 | -18 | 22 |
| .1 | 87 | 65 | -42 | 22 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 51 | 24 | -3 | 23 |
| .5 | 65 | 39 | -15 | 24 |

| | | | | |
|---|---|---|---|---|
| .1 | 88 | 62 | -38 | 24 |

Consequence: Iso 11 poolf No 22 (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 24 | 14 | -5 | 9 |
| .5 | 34 | 24 | -14 | 10 |
| .1 | 50 | 40 | -30 | 10 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 25 | 13 | -4 | 10 |
| .5 | 34 | 23 | -12 | 11 |
| .1 | 50 | 38 | -27 | 11 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 25 | 14 | -4 | 10 |
| .5 | 34 | 23 | -12 | 10 |
| .1 | 49 | 38 | -27 | 10 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 26 | 13 | -3 | 11 |
| .5 | 34 | 22 | -10 | 12 |
| .1 | 49 | 36 | -24 | 12 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 26 | 13 | -3 | 11 |
| .5 | 34 | 22 | -10 | 11 |
| .1 | 48 | 35 | -24 | 11 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 25 | 13 | -4 | 10 |
| .5 | 34 | 23 | -12 | 11 |
| .1 | 50 | 38 | -27 | 11 |

Consequence: Iso 11 poolf No 70 (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 27 | 14 | -3 | 11 |
| .5 | 37 | 24 | -12 | 12 |
| .1 | 53 | 41 | -29 | 12 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 28 | 14 | -2 | 12 |
| .5 | 38 | 24 | -11 | 13 |
| .1 | 53 | 40 | -26 | 13 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 28 | 14 | -2 | 12 |
| .5 | 37 | 23 | -11 | 13 |
| .1 | 52 | 39 | -26 | 13 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 29 | 14 | -2 | 13 |
| .5 | 38 | 23 | -9 | 14 |
| .1 | 52 | 37 | -24 | 14 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 29 | 13 | -1 | 14 |
| .5 | 38 | 22 | -8 | 14 |
| .1 | 52 | 36 | -22 | 14 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 28 | 14 | -2 | 12 |
| .5 | 38 | 24 | -11 | 13 |
| .1 | 53 | 40 | -26 | 13 |

Consequence: Iso 11 poolf No 7m (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 20 | 12 | -5 | 7 |
| .5 | 28 | 20 | -13 | 7 |
| .1 | 42 | 34 | -26 | 7 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 18 | 10 | -4 | 7 |
| .5 | 25 | 17 | -10 | 7 |
| .1 | 37 | 29 | -22 | 7 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 20 | 11 | -4 | 7 |
| .5 | 28 | 19 | -11 | 8 |
| .1 | 40 | 32 | -24 | 8 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 19 | 10 | -3 | 8 |
| .5 | 25 | 16 | -8 | 8 |
| .1 | 36 | 27 | -19 | 8 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 21 | 11 | -3 | 8 |
| .5 | 27 | 18 | -9 | 9 |

| | | | | |
|---|---|---|---|---|
| .1 | 39 | 29 | -20 | 9 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 18 | 10 | -4 | 7 |
| .5 | 25 | 17 | -10 | 7 |
| .1 | 37 | 29 | -22 | 7 |

Consequence: Iso 11 poolf No ru (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 32 | 15 | 1 | 17 |
| .5 | 42 | 25 | -8 | 17 |
| .1 | 59 | 42 | -24 | 17 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 33 | 14 | 1 | 17 |
| .5 | 43 | 24 | -7 | 18 |
| .1 | 59 | 40 | -22 | 18 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 32 | 14 | 0 | 16 |
| .5 | 41 | 24 | -7 | 17 |
| .1 | 57 | 40 | -23 | 17 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 35 | 14 | 3 | 19 |
| .5 | 43 | 23 | -4 | 19 |
| .1 | 58 | 38 | -19 | 19 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 35 | 14 | 3 | 19 |
| .5 | 43 | 23 | -4 | 19 |
| .1 | 57 | 37 | -18 | 19 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 33 | 14 | 1 | 17 |
| .5 | 43 | 24 | -7 | 18 |
| .1 | 59 | 40 | -22 | 18 |

Consequence: Iso 12 late Man 22 (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 33 | 3 | 27 | 30 |
| .5 | 33 | 3 | 26 | 29 |
| .1 | 35 | 4 | 24 | 29 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 33 | 3 | 27 | 30 |
| .5 | 34 | 4 | 25 | 29 |
| .1 | 36 | 4 | 24 | 30 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| .5 | 13 | 3 | 6 | 17 |
| 1 | 12 | 5 | 7 | 15 |
| .1 | 15 | 5 | 5 | 20 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 22 | 2 | 17 | 20 |
| .5 | 24 | 4 | 16 | 20 |
| .1 | 25 | 5 | 15 | 20 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| .01 | 2 | 1 | 0 | 1 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 12 | 2 | 7 | 15 |
| .5 | 13 | 3 | 6 | 17 |
| .1 | 15 | 5 | 5 | 20 |

Consequence: Iso 12 late Man 70 (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 54 | 4 | 46 | 50 |
| .5 | 55 | 5 | 44 | 49 |
| .1 | 58 | 8 | 42 | 50 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 44 | 4 | 36 | 40 |
| .5 | 46 | 6 | 34 | 40 |
| .1 | 48 | 8 | 31 | 40 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 44 | 4 | 36 | 40 |
| .5 | 45 | 5 | 35 | 40 |
| .1 | 47 | 7 | 33 | 40 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 44 | 4 | 36 | 40 |
| .5 | 46 | 6 | 34 | 40 |
| .1 | 48 | 8 | 31 | 40 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 34 | 4 | 26 | 30 |
| .5 | 35 | 5 | 24 | 30 |
| .1 | 38 | 8 | 22 | 30 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 44 | 4 | 36 | 40 |
| .5 | 46 | 6 | 33 | 40 |
| .1 | 49 | 9 | 31 | 40 |

Consequence: Iso 12 late Man ru (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 129 | 9 | 110 | 119 |
| .5 | 134 | 13 | 107 | 120 |
| .1 | 139 | 19 | 101 | 120 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 108 | 8 | 92 | 100 |
| .5 | 112 | 12 | 87 | 99 |
| .1 | 118 | 17 | 83 | 100 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 120 | 10 | 100 | 110 |
| .5 | 125 | 15 | 95 | 110 |
| .1 | 130 | 20 | 90 | 110 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 98 | 8 | 81 | 89 |
| .5 | 103 | 13 | 77 | 90 |
| .1 | 108 | 18 | 72 | 90 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 109 | 8 | 92 | 100 |
| .5 | 114 | 13 | 87 | 100 |
| .1 | 119 | 19 | 81 | 100 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 88 | 8 | 72 | 80 |
| .5 | 93 | 13 | 67 | 80 |
| .1 | 98 | 18 | 62 | 80 |

Consequence: Iso 12 late No 22 (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 54 | 4 | 46 | 50 |
| .5 | 55 | 5 | 44 | 49 |
| .1 | 58 | 8 | 42 | 50 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 44 | 4 | 36 | 40 |
| .5 | 46 | 6 | 34 | 40 |
| .1 | 48 | 8 | 31 | 40 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 44 | 4 | 36 | 40 |
| .5 | 45 | 5 | 35 | 40 |
| .1 | 47 | 7 | 33 | 40 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 44 | 4 | 36 | 40 |
| .5 | 46 | 6 | 34 | 40 |
| .1 | 48 | 8 | 31 | 40 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 34 | 4 | 26 | 30 |
| .5 | 35 | 5 | 24 | 30 |
| .1 | 38 | 8 | 22 | 30 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 44 | 4 | 36 | 40 |
| .5 | 46 | 6 | 33 | 40 |
| .1 | 49 | 9 | 31 | 40 |

Consequence: Iso 12 late No 70 (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 54 | 4 | 46 | 50 |
| .5 | 55 | 5 | 44 | 49 |
| .1 | 58 | 8 | 42 | 50 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 44 | 4 | 36 | 40 |
| .5 | 46 | 6 | 34 | 40 |
| .1 | 48 | 8 | 31 | 40 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 44 | 4 | 36 | 40 |
| .5 | 45 | 5 | 35 | 40 |
| .1 | 47 | 7 | 33 | 40 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 44 | 4 | 36 | 40 |
| .5 | 46 | 6 | 34 | 40 |
| .1 | 48 | 8 | 31 | 40 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 34 | 4 | 26 | 30 |
| .5 | 35 | 5 | 24 | 30 |
| .1 | 38 | 8 | 22 | 30 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 44 | 4 | 36 | 40 |
| .5 | 46 | 6 | 33 | 40 |
| .1 | 49 | 9 | 31 | 40 |

Consequence: Iso 12 late No ru (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 129 | 9 | 110 | 119 |
| .5 | 134 | 13 | 107 | 120 |
| .1 | 139 | 19 | 101 | 120 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 108 | 8 | 92 | 100 |
| .5 | 112 | 12 | 87 | 99 |
| .1 | 118 | 17 | 83 | 100 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 120 | 10 | 100 | 110 |
| .5 | 125 | 15 | 95 | 110 |
| .1 | 130 | 20 | 90 | 110 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 98 | 8 | 81 | 89 |
| .5 | 103 | 13 | 77 | 90 |
| .1 | 108 | 18 | 72 | 90 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 109 | 8 | 92 | 100 |
| .5 | 114 | 13 | 87 | 100 |
| .1 | 119 | 19 | 81 | 100 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|

| | | | | |
|---|---|---|---|---|
| 1 | 88 | 8 | 72 | 80 |
| .5 | 93 | 13 | 67 | 80 |
| .1 | 98 | 18 | 62 | 80 |

Consequence: Iso 12 poolf Man 22 (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 47 | 35 | -24 | 11 |
| .5 | 69 | 57 | -45 | 12 |
| .1 | 106 | 94 | -81 | 12 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 45 | 31 | -20 | 12 |
| .5 | 65 | 51 | -38 | 13 |
| .1 | 98 | 84 | -71 | 13 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 49 | 34 | -22 | 13 |
| .5 | 69 | 55 | -41 | 13 |
| .1 | 103 | 89 | -76 | 13 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 47 | 30 | -18 | 14 |
| .5 | 65 | 48 | -34 | 15 |
| .1 | 94 | 78 | -64 | 15 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 50 | 32 | -20 | 14 |
| .5 | 68 | 51 | -36 | 15 |
| .1 | 99 | 82 | -67 | 15 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 48 | 29 | -16 | 15 |
| .5 | 64 | 46 | -31 | 16 |
| .1 | 91 | 74 | -58 | 16 |

Consequence: Iso 12 poolf Man 70 (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 121 | 103 | -86 | 18 |
| .5 | 176 | 159 | -142 | 18 |
| .1 | 271 | 253 | -235 | 18 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 115 | 94 | -75 | 20 |
| .5 | 165 | 145 | -125 | 20 |
| .1 | 250 | 230 | -209 | 21 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 124 | 101 | -81 | 22 |
| .5 | 177 | 155 | -133 | 22 |
| .1 | 268 | 246 | -224 | 22 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 118 | 91 | -71 | 24 |
| .5 | 166 | 139 | -115 | 25 |
| .1 | 244 | 219 | -196 | 24 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 127 | 98 | -76 | 25 |
| .5 | 175 | 147 | -122 | 27 |
| .1 | 259 | 231 | -207 | 26 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 120 | 89 | -66 | 27 |
| .5 | 165 | 133 | -106 | 30 |
| .1 | 239 | 208 | -180 | 29 |

Consequence: Iso 12 poolf Man 7m (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 19 | 12 | -6 | 6 |
| .5 | 27 | 20 | -13 | 7 |
| .1 | 41 | 34 | -27 | 7 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 18 | 10 | -4 | 7 |
| .5 | 25 | 17 | -10 | 8 |
| .1 | 37 | 29 | -21 | 8 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 20 | 12 | -5 | 7 |
| .5 | 27 | 19 | -12 | 8 |
| .1 | 39 | 32 | -24 | 7 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 19 | 10 | -3 | 8 |
| .5 | 26 | 16 | -8 | 9 |
| .1 | 36 | 27 | -18 | 9 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|

| | | | | |
|---|---|---|---|---|
| 1 | 21 | 11 | -4 | 9 |
| .5 | 27 | 18 | -9 | 9 |
| .1 | 38 | 29 | -20 | 9 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 19 | 9 | -2 | 9 |
| .5 | 25 | 15 | -7 | 9 |
| .1 | 34 | 25 | -16 | 9 |

Consequence: Iso 12 poolf Man ru (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 124 | 103 | -83 | 21 |
| .5 | 180 | 160 | -138 | 21 |
| .1 | 274 | 253 | -233 | 20 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 126 | 100 | -77 | 24 |
| .5 | 179 | 154 | -130 | 25 |
| .1 | 268 | 244 | -219 | 24 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 129 | 101 | -77 | 26 |
| .5 | 181 | 155 | -131 | 25 |
| .1 | 272 | 247 | -222 | 25 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 132 | 99 | -72 | 30 |
| .5 | 183 | 150 | -120 | 32 |
| .1 | 267 | 235 | -205 | 31 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 136 | 100 | -70 | 33 |
| .5 | 187 | 150 | -117 | 35 |
| .1 | 271 | 236 | -204 | 33 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 134 | 97 | -71 | 32 |
| .5 | 182 | 146 | -114 | 34 |
| .1 | 262 | 227 | -193 | 34 |

Consequence: Iso 12 poolf No 22 (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 47 | 35 | -24 | 11 |
| .5 | 69 | 57 | -45 | 12 |
| .1 | 106 | 94 | -81 | 12 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 45 | 31 | -20 | 12 |
| .5 | 65 | 51 | -38 | 13 |
| .1 | 98 | 84 | -71 | 13 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 49 | 34 | -22 | 13 |
| .5 | 69 | 55 | -41 | 13 |
| .1 | 103 | 89 | -76 | 13 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 47 | 30 | -18 | 14 |
| .5 | 65 | 48 | -34 | 15 |
| .1 | 94 | 78 | -64 | 15 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 50 | 32 | -20 | 14 |
| .5 | 68 | 51 | -36 | 15 |
| .1 | 99 | 82 | -67 | 15 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 48 | 29 | -16 | 15 |
| .5 | 64 | 46 | -31 | 16 |
| .1 | 91 | 74 | -58 | 16 |

Consequence: Iso 12 poolf No 70 (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 121 | 103 | -86 | 18 |
| .5 | 176 | 159 | -142 | 18 |
| .1 | 271 | 253 | -235 | 18 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 115 | 94 | -75 | 20 |
| .5 | 165 | 145 | -125 | 20 |
| .1 | 250 | 230 | -209 | 21 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 124 | 101 | -81 | 22 |
| .5 | 177 | 155 | -133 | 22 |
| .1 | 268 | 246 | -224 | 22 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|

| | | | | |
|---|---|---|---|---|
| 1 | 118 | 91 | -71 | 24 |
| .5 | 166 | 139 | -115 | 25 |
| .1 | 244 | 219 | -196 | 24 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 127 | 98 | -76 | 25 |
| .5 | 175 | 147 | -122 | 27 |
| .1 | 259 | 231 | -207 | 26 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 120 | 89 | -66 | 27 |
| .5 | 165 | 133 | -106 | 30 |
| .1 | 239 | 208 | -180 | 29 |

Consequence: Iso 12 poolf No 7m (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 19 | 12 | -6 | 6 |
| .5 | 27 | 20 | -13 | 7 |
| .1 | 41 | 34 | -27 | 7 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 18 | 10 | -4 | 7 |
| .5 | 25 | 17 | -10 | 8 |
| .1 | 37 | 29 | -21 | 8 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 20 | 12 | -5 | 7 |
| .5 | 27 | 19 | -12 | 8 |
| .1 | 39 | 32 | -24 | 7 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 19 | 10 | -3 | 8 |
| .5 | 26 | 16 | -8 | 9 |
| .1 | 36 | 27 | -18 | 9 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 21 | 11 | -4 | 9 |
| .5 | 27 | 18 | -9 | 9 |
| .1 | 38 | 29 | -20 | 9 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 19 | 9 | -2 | 9 |
| .5 | 25 | 15 | -7 | 9 |
| .1 | 34 | 25 | -16 | 9 |

Consequence: Iso 12 poolf No ru (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 124 | 103 | -83 | 21 |
| .5 | 180 | 160 | -138 | 21 |
| .1 | 274 | 253 | -233 | 20 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 126 | 100 | -77 | 24 |
| .5 | 179 | 154 | -130 | 25 |
| .1 | 268 | 244 | -219 | 24 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 129 | 101 | -77 | 26 |
| .5 | 181 | 155 | -131 | 25 |
| .1 | 272 | 247 | -222 | 25 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 132 | 99 | -72 | 30 |
| .5 | 183 | 150 | -120 | 32 |
| .1 | 267 | 235 | -205 | 31 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 136 | 100 | -70 | 33 |
| .5 | 187 | 150 | -117 | 35 |
| .1 | 271 | 236 | -204 | 33 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 134 | 97 | -71 | 32 |
| .5 | 182 | 146 | -114 | 34 |
| .1 | 262 | 227 | -193 | 34 |

Consequence: Iso 13 late Man 22 (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 23 | 3 | 17 | 20 |
| .5 | 24 | 4 | 16 | 20 |
| .1 | 26 | 6 | 14 | 20 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 23 | 3 | 17 | 20 |
| .5 | 24 | 4 | 16 | 20 |
| .1 | 26 | 6 | 14 | 20 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|

| | | | | |
|---|---|---|---|---|
| 1 | 23 | 3 | 17 | 20 |
| .5 | 24 | 4 | 16 | 20 |
| .1 | 26 | 6 | 14 | 20 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 23 | 3 | 17 | 20 |
| .5 | 24 | 4 | 16 | 20 |
| .1 | 26 | 6 | 14 | 20 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 23 | 3 | 17 | 20 |
| .5 | 24 | 4 | 16 | 20 |
| .1 | 26 | 6 | 14 | 20 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 23 | 3 | 17 | 20 |
| .5 | 24 | 4 | 16 | 20 |
| .1 | 26 | 6 | 14 | 20 |

Consequence: Iso 13 late Man 70 (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 34 | 4 | 26 | 30 |
| .5 | 36 | 6 | 24 | 30 |
| .1 | 38 | 8 | 22 | 30 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 34 | 4 | 26 | 30 |
| .5 | 36 | 6 | 24 | 30 |
| .1 | 38 | 8 | 22 | 30 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 44 | 4 | 36 | 40 |
| .5 | 46 | 6 | 34 | 40 |
| .1 | 48 | 8 | 32 | 40 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 44 | 4 | 36 | 40 |
| .5 | 46 | 6 | 34 | 40 |
| .1 | 48 | 8 | 32 | 40 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 34 | 4 | 26 | 30 |
| .5 | 36 | 6 | 24 | 30 |
| .1 | 38 | 8 | 22 | 30 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 34 | 4 | 26 | 30 |
| .5 | 36 | 6 | 24 | 30 |
| .1 | 38 | 8 | 22 | 30 |

Consequence: Iso 13 late Man ru (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 32 | 2 | 27 | 30 |
| .5 | 34 | 4 | 26 | 30 |
| .1 | 35 | 5 | 25 | 30 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 23 | 3 | 17 | 20 |
| .5 | 24 | 4 | 16 | 20 |
| .1 | 25 | 5 | 15 | 20 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 23 | 3 | 17 | 20 |
| .5 | 24 | 4 | 16 | 20 |
| .1 | 25 | 5 | 15 | 20 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 23 | 3 | 17 | 20 |
| .5 | 24 | 4 | 16 | 20 |
| .1 | 25 | 5 | 15 | 20 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 23 | 3 | 17 | 20 |
| .5 | 24 | 4 | 16 | 20 |
| .1 | 25 | 5 | 15 | 20 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 13 | 3 | 7 | 10 |
| .5 | 14 | 4 | 6 | 10 |
| .1 | 16 | 6 | 4 | 10 |

Consequence: Iso 13 late No 22 (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 23 | 3 | 17 | 20 |
| .5 | 24 | 4 | 16 | 20 |
| .1 | 26 | 6 | 14 | 20 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|

| | | | | |
|---|---|---|---|---|
| 1 | 23 | 3 | 17 | 20 |
| .5 | 24 | 4 | 16 | 20 |
| .1 | 26 | 6 | 14 | 20 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 23 | 3 | 17 | 20 |
| .5 | 24 | 4 | 16 | 20 |
| .1 | 26 | 6 | 14 | 20 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 23 | 3 | 17 | 20 |
| .5 | 24 | 4 | 16 | 20 |
| .1 | 26 | 6 | 14 | 20 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 23 | 3 | 17 | 20 |
| .5 | 24 | 4 | 16 | 20 |
| .1 | 26 | 6 | 14 | 20 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 23 | 3 | 17 | 20 |
| .5 | 24 | 4 | 16 | 20 |
| .1 | 26 | 6 | 14 | 20 |

Consequence: Iso 13 late No 70 (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 34 | 4 | 26 | 30 |
| .5 | 36 | 6 | 24 | 30 |
| .1 | 38 | 8 | 22 | 30 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 34 | 4 | 26 | 30 |
| .5 | 36 | 6 | 24 | 30 |
| .1 | 38 | 8 | 22 | 30 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 44 | 4 | 36 | 40 |
| .5 | 46 | 6 | 34 | 40 |
| .1 | 48 | 8 | 32 | 40 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 44 | 4 | 36 | 40 |
| .5 | 46 | 6 | 34 | 40 |
| .1 | 48 | 8 | 32 | 40 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 34 | 4 | 26 | 30 |
| .5 | 36 | 6 | 24 | 30 |
| .1 | 38 | 8 | 22 | 30 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 34 | 4 | 26 | 30 |
| .5 | 36 | 6 | 24 | 30 |
| .1 | 38 | 8 | 22 | 30 |

Consequence: Iso 13 late No ru (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 32 | 2 | 27 | 30 |
| .5 | 34 | 4 | 26 | 30 |
| .1 | 35 | 5 | 25 | 30 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 23 | 3 | 17 | 20 |
| .5 | 24 | 4 | 16 | 20 |
| .1 | 25 | 5 | 15 | 20 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 23 | 3 | 17 | 20 |
| .5 | 24 | 4 | 16 | 20 |
| .1 | 25 | 5 | 15 | 20 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 23 | 3 | 17 | 20 |
| .5 | 24 | 4 | 16 | 20 |
| .1 | 25 | 5 | 15 | 20 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 23 | 3 | 17 | 20 |
| .5 | 24 | 4 | 16 | 20 |
| .1 | 25 | 5 | 15 | 20 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 13 | 3 | 7 | 10 |
| .5 | 14 | 4 | 6 | 10 |
| .1 | 16 | 6 | 4 | 10 |

Consequence: Iso 13 poolf Man 22 (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|

| | | | | |
|---|---|---|---|---|
| 1 | 40 | 29 | -18 | 11 |
| .5 | 59 | 47 | -35 | 11 |
| .1 | 89 | 77 | -66 | 11 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 42 | 28 | -16 | 12 |
| .5 | 59 | 46 | -32 | 13 |
| .1 | 89 | 75 | -62 | 13 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 42 | 28 | -16 | 12 |
| .5 | 59 | 45 | -32 | 13 |
| .1 | 88 | 74 | -61 | 13 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 44 | 27 | -15 | 14 |
| .5 | 60 | 44 | -29 | 15 |
| .1 | 87 | 71 | -57 | 15 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 44 | 27 | -15 | 14 |
| .5 | 59 | 43 | -29 | 15 |
| .1 | 85 | 70 | -56 | 14 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 45 | 26 | -14 | 15 |
| .5 | 60 | 42 | -27 | 16 |
| .1 | 85 | 68 | -53 | 15 |

Consequence: Iso 13 poolf Man 70 (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 42 | 29 | -16 | 13 |
| .5 | 61 | 47 | -33 | 13 |
| .1 | 91 | 77 | -64 | 13 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 44 | 28 | -14 | 15 |
| .5 | 62 | 46 | -30 | 15 |
| .1 | 91 | 75 | -60 | 15 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 44 | 28 | -14 | 14 |
| .5 | 61 | 45 | -30 | 15 |
| .1 | 90 | 74 | -59 | 15 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 45 | 27 | -13 | 16 |
| .5 | 62 | 44 | -28 | 17 |
| .1 | 89 | 71 | -54 | 17 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 46 | 27 | -12 | 17 |
| .5 | 62 | 43 | -26 | 17 |
| .1 | 88 | 70 | -53 | 17 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 47 | 26 | -12 | 17 |
| .5 | 62 | 42 | -25 | 18 |
| .1 | 87 | 68 | -51 | 17 |

Consequence: Iso 13 poolf Man 7m (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 20 | 12 | -5 | 7 |
| .5 | 28 | 20 | -13 | 7 |
| .1 | 42 | 34 | -26 | 7 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 18 | 10 | -4 | 7 |
| .5 | 25 | 17 | -10 | 7 |
| .1 | 37 | 29 | -22 | 7 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 20 | 11 | -4 | 7 |
| .5 | 28 | 19 | -11 | 8 |
| .1 | 40 | 32 | -24 | 8 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 19 | 10 | -3 | 8 |
| .5 | 25 | 16 | -8 | 8 |
| .1 | 36 | 27 | -19 | 8 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 21 | 11 | -3 | 8 |
| .5 | 27 | 18 | -9 | 9 |
| .1 | 39 | 29 | -20 | 9 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 20 | 9 | -2 | 9 |
| .5 | 26 | 15 | -7 | 9 |

| | | | | |
|---|---|---|---|---|
| .1 | 35 | 25 | -16 | 9 |

Consequence: Iso 13 poolf Man ru (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 48 | 29 | -10 | 18 |
| .5 | 66 | 47 | -28 | 18 |
| .1 | 96 | 77 | -59 | 18 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 48 | 28 | -10 | 19 |
| .5 | 66 | 46 | -26 | 19 |
| .1 | 95 | 75 | -56 | 19 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 48 | 28 | -10 | 19 |
| .5 | 65 | 45 | -26 | 19 |
| .1 | 94 | 74 | -55 | 19 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 51 | 27 | -8 | 21 |
| .5 | 67 | 44 | -22 | 22 |
| .1 | 94 | 71 | -49 | 22 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 51 | 27 | -8 | 21 |
| .5 | 67 | 43 | -21 | 22 |
| .1 | 93 | 70 | -48 | 22 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 96 | 62 | -35 | 30 |
| .5 | 129 | 94 | -63 | 32 |
| .1 | 181 | 149 | -118 | 31 |

Consequence: Iso 13 poolf No 22 (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 40 | 29 | -18 | 11 |
| .5 | 59 | 47 | -35 | 11 |
| .1 | 89 | 77 | -66 | 11 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 42 | 28 | -16 | 12 |
| .5 | 59 | 46 | -32 | 13 |
| .1 | 89 | 75 | -62 | 13 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 42 | 28 | -16 | 12 |
| .5 | 59 | 45 | -32 | 13 |
| .1 | 88 | 74 | -61 | 13 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 44 | 27 | -15 | 14 |
| .5 | 60 | 44 | -29 | 15 |
| .1 | 87 | 71 | -57 | 15 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 44 | 27 | -15 | 14 |
| .5 | 59 | 43 | -29 | 15 |
| .1 | 85 | 70 | -56 | 14 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 42 | 28 | -16 | 12 |
| .5 | 59 | 46 | -32 | 13 |
| .1 | 89 | 75 | -62 | 13 |

Consequence: Iso 13 poolf No 70 (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 42 | 29 | -16 | 13 |
| .5 | 61 | 47 | -33 | 13 |
| .1 | 91 | 77 | -64 | 13 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 44 | 28 | -14 | 15 |
| .5 | 62 | 46 | -30 | 15 |
| .1 | 91 | 75 | -60 | 15 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 44 | 28 | -14 | 14 |
| .5 | 61 | 45 | -30 | 15 |
| .1 | 90 | 74 | -59 | 15 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 45 | 27 | -13 | 16 |
| .5 | 62 | 44 | -28 | 17 |
| .1 | 89 | 71 | -54 | 17 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 46 | 27 | -12 | 17 |
| .5 | 62 | 43 | -26 | 17 |

| | | | | |
|---|---|---|---|---|
| .1 | 88 | 70 | -53 | 17 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 44 | 28 | -14 | 15 |
| .5 | 62 | 46 | -30 | 15 |
| .1 | 91 | 75 | -60 | 15 |

Consequence: Iso 13 poolf No 7m (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 20 | 12 | -5 | 7 |
| .5 | 28 | 20 | -13 | 7 |
| .1 | 42 | 34 | -26 | 7 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 18 | 10 | -4 | 7 |
| .5 | 25 | 17 | -10 | 7 |
| .1 | 37 | 29 | -22 | 7 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 20 | 11 | -4 | 7 |
| .5 | 28 | 19 | -11 | 8 |
| .1 | 40 | 32 | -24 | 8 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 19 | 10 | -3 | 8 |
| .5 | 25 | 16 | -8 | 8 |
| .1 | 36 | 27 | -19 | 8 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 21 | 11 | -3 | 8 |
| .5 | 27 | 18 | -9 | 9 |
| .1 | 39 | 29 | -20 | 9 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 18 | 10 | -4 | 7 |
| .5 | 25 | 17 | -10 | 7 |
| .1 | 37 | 29 | -22 | 7 |

Consequence: Iso 13 poolf No ru (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 48 | 29 | -10 | 18 |
| .5 | 66 | 47 | -28 | 18 |
| .1 | 96 | 77 | -59 | 18 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 48 | 28 | -10 | 19 |
| .5 | 66 | 46 | -26 | 19 |
| .1 | 95 | 75 | -56 | 19 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 48 | 28 | -10 | 19 |
| .5 | 65 | 45 | -26 | 19 |
| .1 | 94 | 74 | -55 | 19 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 51 | 27 | -8 | 21 |
| .5 | 67 | 44 | -22 | 22 |
| .1 | 94 | 71 | -49 | 22 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 51 | 27 | -8 | 21 |
| .5 | 67 | 43 | -21 | 22 |
| .1 | 93 | 70 | -48 | 22 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 48 | 28 | -10 | 19 |
| .5 | 66 | 46 | -26 | 19 |
| .1 | 95 | 75 | -56 | 19 |

Consequence: Iso 14 late Man 22 (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 22 | 2 | 18 | 20 |
| .5 | 23 | 3 | 17 | 20 |
| .1 | 25 | 5 | 15 | 20 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 22 | 2 | 18 | 20 |
| .5 | 23 | 3 | 17 | 20 |
| .1 | 25 | 5 | 15 | 20 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 22 | 2 | 18 | 20 |
| .5 | 23 | 3 | 17 | 20 |
| .1 | 25 | 5 | 15 | 20 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 22 | 2 | 18 | 20 |
| .5 | 23 | 3 | 17 | 20 |

| | | | | |
|---|---|---|---|---|
| .1 | 25 | 5 | 15 | 20 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 12 | 2 | 8 | 10 |
| .5 | 13 | 3 | 7 | 10 |
| .1 | 14 | 4 | 6 | 10 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 12 | 2 | 8 | 10 |
| .5 | 13 | 3 | 7 | 10 |
| .1 | 14 | 4 | 6 | 10 |

Consequence: Iso 14 late Man 70 (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 43 | 3 | 36 | 40 |
| .5 | 45 | 5 | 35 | 40 |
| .1 | 47 | 7 | 33 | 40 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 33 | 3 | 27 | 30 |
| .5 | 35 | 5 | 25 | 30 |
| .1 | 36 | 6 | 23 | 29 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 33 | 3 | 27 | 30 |
| .5 | 35 | 5 | 25 | 30 |
| .1 | 36 | 6 | 23 | 29 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 33 | 3 | 27 | 30 |
| .5 | 35 | 5 | 25 | 30 |
| .1 | 36 | 6 | 23 | 29 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 33 | 3 | 27 | 30 |
| .5 | 35 | 5 | 25 | 30 |
| .1 | 36 | 6 | 23 | 29 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 23 | 3 | 17 | 20 |
| .5 | 25 | 5 | 15 | 20 |
| .1 | 26 | 6 | 13 | 20 |

Consequence: Iso 14 late Man ru (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 37 | 7 | 23 | 30 |
| .5 | 40 | 10 | 20 | 30 |
| .1 | 45 | 15 | 15 | 30 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 67 | 7 | 53 | 60 |
| .5 | 71 | 11 | 49 | 60 |
| .1 | 75 | 15 | 45 | 60 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 47 | 7 | 33 | 40 |
| .5 | 50 | 10 | 30 | 40 |
| .1 | 55 | 15 | 25 | 40 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 67 | 7 | 53 | 60 |
| .5 | 71 | 11 | 49 | 60 |
| .1 | 75 | 15 | 45 | 60 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 77 | 7 | 63 | 70 |
| .5 | 80 | 10 | 60 | 70 |
| .1 | 85 | 15 | 55 | 70 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 57 | 7 | 43 | 50 |
| .5 | 60 | 10 | 40 | 50 |
| .1 | 64 | 14 | 36 | 50 |

Consequence: Iso 14 late No 22 (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 22 | 2 | 18 | 20 |
| .5 | 23 | 3 | 17 | 20 |
| .1 | 25 | 5 | 15 | 20 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 22 | 2 | 18 | 20 |
| .5 | 23 | 3 | 17 | 20 |
| .1 | 25 | 5 | 15 | 20 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 22 | 2 | 18 | 20 |
| .5 | 23 | 3 | 17 | 20 |

| | | | | |
|---|---|---|---|---|
| .1 | 25 | 5 | 15 | 20 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 22 | 2 | 18 | 20 |
| .5 | 23 | 3 | 17 | 20 |
| .1 | 25 | 5 | 15 | 20 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 12 | 2 | 8 | 10 |
| .5 | 13 | 3 | 7 | 10 |
| .1 | 14 | 4 | 6 | 10 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 12 | 2 | 8 | 10 |
| .5 | 13 | 3 | 7 | 10 |
| .1 | 14 | 4 | 6 | 10 |

Consequence: Iso 14 late No 70 (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 43 | 3 | 36 | 40 |
| .5 | 45 | 5 | 35 | 40 |
| .1 | 47 | 7 | 33 | 40 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 33 | 3 | 27 | 30 |
| .5 | 35 | 5 | 25 | 30 |
| .1 | 36 | 6 | 23 | 29 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 33 | 3 | 27 | 30 |
| .5 | 35 | 5 | 25 | 30 |
| .1 | 36 | 6 | 23 | 29 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 33 | 3 | 27 | 30 |
| .5 | 35 | 5 | 25 | 30 |
| .1 | 36 | 6 | 23 | 29 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 33 | 3 | 27 | 30 |
| .5 | 35 | 5 | 25 | 30 |
| .1 | 36 | 6 | 23 | 29 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 23 | 3 | 17 | 20 |
| .5 | 25 | 5 | 15 | 20 |
| .1 | 26 | 6 | 13 | 20 |

Consequence: Iso 14 late No ru (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 37 | 7 | 23 | 30 |
| .5 | 40 | 10 | 20 | 30 |
| .1 | 45 | 15 | 15 | 30 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 67 | 7 | 53 | 60 |
| .5 | 71 | 11 | 49 | 60 |
| .1 | 75 | 15 | 45 | 60 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 47 | 7 | 33 | 40 |
| .5 | 50 | 10 | 30 | 40 |
| .1 | 55 | 15 | 25 | 40 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 67 | 7 | 53 | 60 |
| .5 | 71 | 11 | 49 | 60 |
| .1 | 75 | 15 | 45 | 60 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 77 | 7 | 63 | 70 |
| .5 | 80 | 10 | 60 | 70 |
| .1 | 85 | 15 | 55 | 70 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 57 | 7 | 43 | 50 |
| .5 | 60 | 10 | 40 | 50 |
| .1 | 64 | 14 | 36 | 50 |

Consequence: Iso 14 poolf Man 22 (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 36 | 27 | -19 | 8 |
| .5 | 53 | 44 | -35 | 8 |
| .1 | 82 | 73 | -64 | 8 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 34 | 24 | -16 | 9 |
| .5 | 50 | 40 | -30 | 9 |

| | | | | |
|---|---|---|---|---|
| .1 | 75 | 65 | -56 | 9 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 37 | 26 | -18 | 9 |
| .5 | 53 | 42 | -32 | 10 |
| .1 | 81 | 69 | -59 | 10 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 35 | 23 | -15 | 10 |
| .5 | 49 | 37 | -27 | 11 |
| .1 | 73 | 61 | -50 | 11 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 38 | 25 | -16 | 10 |
| .5 | 52 | 39 | -29 | 11 |
| .1 | 76 | 64 | -53 | 11 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 36 | 22 | -14 | 11 |
| .5 | 49 | 36 | -25 | 11 |
| .1 | 70 | 57 | -46 | 11 |

Consequence: Iso 14 poolf Man 70 (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 39 | 29 | -19 | 9 |
| .5 | 57 | 47 | -37 | 10 |
| .1 | 88 | 77 | -67 | 10 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 40 | 28 | -18 | 10 |
| .5 | 58 | 46 | -34 | 11 |
| .1 | 87 | 75 | -64 | 11 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 41 | 28 | -18 | 11 |
| .5 | 58 | 45 | -34 | 11 |
| .1 | 87 | 74 | -63 | 12 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 42 | 27 | -17 | 12 |
| .5 | 58 | 44 | -32 | 13 |
| .1 | 85 | 71 | -59 | 13 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 42 | 27 | -17 | 12 |
| .5 | 57 | 43 | -31 | 12 |
| .1 | 83 | 70 | -58 | 12 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 42 | 26 | -17 | 12 |
| .5 | 57 | 42 | -30 | 13 |
| .1 | 82 | 68 | -55 | 13 |

Consequence: Iso 14 poolf Man 7m (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 14 | 9 | -4 | 5 |
| .5 | 21 | 15 | -10 | 5 |
| .1 | 31 | 26 | -20 | 5 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 13 | 7 | -3 | 5 |
| .5 | 19 | 13 | -7 | 5 |
| .1 | 28 | 22 | -16 | 6 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 15 | 8 | -3 | 5 |
| .5 | 21 | 14 | -8 | 6 |
| .1 | 30 | 24 | -18 | 6 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 14 | 7 | -1 | 6 |
| .5 | 19 | 12 | -6 | 6 |
| .1 | 27 | 20 | -13 | 7 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 16 | 8 | -2 | 6 |
| .5 | 21 | 13 | -7 | 7 |
| .1 | 29 | 22 | -15 | 7 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 15 | 6 | -1 | 6 |
| .5 | 19 | 11 | -5 | 6 |
| .1 | 26 | 18 | -12 | 6 |

Consequence: Iso 14 poolf Man ru (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 40 | 29 | -18 | 10 |
| .5 | 58 | 47 | -36 | 11 |

| | | | | |
|---|---|---|---|---|
| .1 | 88 | 77 | -67 | 10 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 42 | 28 | -16 | 12 |
| .5 | 59 | 46 | -32 | 13 |
| .1 | 89 | 75 | -62 | 13 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 41 | 28 | -17 | 11 |
| .5 | 58 | 45 | -33 | 12 |
| .1 | 87 | 74 | -63 | 12 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 43 | 27 | -16 | 13 |
| .5 | 59 | 44 | -30 | 14 |
| .1 | 86 | 71 | -57 | 14 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 43 | 27 | -16 | 13 |
| .5 | 58 | 43 | -30 | 14 |
| .1 | 85 | 70 | -56 | 14 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 43 | 26 | -16 | 13 |
| .5 | 58 | 42 | -29 | 14 |
| .1 | 83 | 68 | -54 | 14 |

Consequence: Iso 14 poolf No 22 (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 36 | 27 | -19 | 8 |
| .5 | 53 | 44 | -35 | 8 |
| .1 | 82 | 73 | -64 | 8 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 34 | 24 | -16 | 9 |
| .5 | 50 | 40 | -30 | 9 |
| .1 | 75 | 65 | -56 | 9 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 37 | 26 | -18 | 9 |
| .5 | 53 | 42 | -32 | 10 |
| .1 | 81 | 69 | -59 | 10 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 35 | 23 | -15 | 10 |
| .5 | 49 | 37 | -27 | 11 |
| .1 | 73 | 61 | -50 | 11 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 38 | 25 | -16 | 10 |
| .5 | 52 | 39 | -29 | 11 |
| .1 | 76 | 64 | -53 | 11 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 34 | 24 | -16 | 9 |
| .5 | 50 | 40 | -30 | 9 |
| .1 | 75 | 65 | -56 | 9 |

Consequence: Iso 14 poolf No 70 (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 39 | 29 | -19 | 9 |
| .5 | 57 | 47 | -37 | 10 |
| .1 | 88 | 77 | -67 | 10 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 40 | 28 | -18 | 10 |
| .5 | 58 | 46 | -34 | 11 |
| .1 | 87 | 75 | -64 | 11 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 41 | 28 | -18 | 11 |
| .5 | 58 | 45 | -34 | 11 |
| .1 | 87 | 74 | -63 | 12 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 42 | 27 | -17 | 12 |
| .5 | 58 | 44 | -32 | 13 |
| .1 | 85 | 71 | -59 | 13 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 42 | 27 | -17 | 12 |
| .5 | 57 | 43 | -31 | 12 |
| .1 | 83 | 70 | -58 | 12 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 40 | 28 | -18 | 10 |
| .5 | 58 | 46 | -34 | 11 |
| .1 | 87 | 75 | -64 | 11 |

Consequence: Iso 14 poolf No 7m (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 14 | 9 | -4 | 5 |
| .5 | 21 | 15 | -10 | 5 |
| .1 | 31 | 26 | -20 | 5 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 13 | 7 | -3 | 5 |
| .5 | 19 | 13 | -7 | 5 |
| .1 | 28 | 22 | -16 | 6 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 15 | 8 | -3 | 5 |
| .5 | 21 | 14 | -8 | 6 |
| .1 | 30 | 24 | -18 | 6 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 14 | 7 | -1 | 6 |
| .5 | 19 | 12 | -6 | 6 |
| .1 | 27 | 20 | -13 | 7 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 16 | 8 | -2 | 6 |
| .5 | 21 | 13 | -7 | 7 |
| .1 | 29 | 22 | -15 | 7 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 13 | 7 | -3 | 5 |
| .5 | 19 | 13 | -7 | 5 |
| .1 | 28 | 22 | -16 | 6 |

Consequence: Iso 14 poolf No ru (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 40 | 29 | -18 | 10 |
| .5 | 58 | 47 | -36 | 11 |
| .1 | 88 | 77 | -67 | 10 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 42 | 28 | -16 | 12 |
| .5 | 59 | 46 | -32 | 13 |
| .1 | 89 | 75 | -62 | 13 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 41 | 28 | -17 | 11 |
| .5 | 58 | 45 | -33 | 12 |
| .1 | 87 | 74 | -63 | 12 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 43 | 27 | -16 | 13 |
| .5 | 59 | 44 | -30 | 14 |
| .1 | 86 | 71 | -57 | 14 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 43 | 27 | -16 | 13 |
| .5 | 58 | 43 | -30 | 14 |
| .1 | 85 | 70 | -56 | 14 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 42 | 28 | -16 | 12 |
| .5 | 59 | 46 | -32 | 13 |
| .1 | 89 | 75 | -62 | 13 |

Consequence: Iso 15 late Man 22 (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 11 | 1 | 8 | 10 |
| .5 | 12 | 2 | 7 | 10 |
| .1 | 13 | 3 | 6 | 10 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 11 | 1 | 8 | 10 |
| .5 | 12 | 2 | 7 | 10 |
| .1 | 13 | 3 | 6 | 10 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 11 | 1 | 8 | 10 |
| .5 | 12 | 2 | 7 | 10 |
| .1 | 13 | 3 | 6 | 10 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 11 | 1 | 8 | 10 |
| .5 | 12 | 2 | 7 | 10 |
| .1 | 13 | 3 | 6 | 10 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 11 | 1 | 8 | 10 |
| .5 | 12 | 2 | 7 | 10 |
| .1 | 13 | 3 | 6 | 10 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 11 | 1 | 8 | 10 |
| .5 | 12 | 2 | 7 | 10 |
| .1 | 13 | 3 | 6 | 10 |

Consequence: Iso 15 late Man 70 (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 23 | 3 | 17 | 20 |
| .5 | 24 | 4 | 16 | 20 |
| .1 | 26 | 6 | 14 | 20 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 23 | 3 | 17 | 20 |
| .5 | 24 | 4 | 16 | 20 |
| .1 | 26 | 6 | 14 | 20 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 23 | 3 | 17 | 20 |
| .5 | 24 | 4 | 16 | 20 |
| .1 | 26 | 6 | 14 | 20 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 23 | 3 | 17 | 20 |
| .5 | 24 | 4 | 16 | 20 |
| .1 | 26 | 6 | 14 | 20 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 23 | 3 | 17 | 20 |
| .5 | 24 | 4 | 16 | 20 |
| .1 | 26 | 6 | 14 | 20 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 12 | 2 | 7 | 9 |
| .5 | 13 | 3 | 7 | 10 |
| .1 | 15 | 5 | 5 | 10 |

Consequence: Iso 15 late Man ru (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 48 | 7 | 33 | 40 |
| .5 | 49 | 9 | 31 | 40 |
| .1 | 53 | 13 | 27 | 40 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 35 | 5 | 25 | 30 |
| .5 | 38 | 8 | 22 | 30 |
| .1 | 41 | 11 | 19 | 30 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 56 | 6 | 44 | 50 |
| .5 | 59 | 9 | 41 | 50 |
| .1 | 63 | 13 | 37 | 50 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 35 | 5 | 25 | 30 |
| .5 | 38 | 8 | 22 | 30 |
| .1 | 41 | 11 | 19 | 30 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 48 | 7 | 33 | 40 |
| .5 | 49 | 9 | 31 | 40 |
| .1 | 53 | 13 | 27 | 40 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 35 | 5 | 25 | 30 |
| .5 | 38 | 8 | 22 | 30 |
| .1 | 41 | 11 | 19 | 30 |

Consequence: Iso 15 late No 22 (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 11 | 1 | 8 | 10 |
| .5 | 12 | 2 | 7 | 10 |
| .1 | 13 | 3 | 6 | 10 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 11 | 1 | 8 | 10 |
| .5 | 12 | 2 | 7 | 10 |
| .1 | 13 | 3 | 6 | 10 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 11 | 1 | 8 | 10 |
| .5 | 12 | 2 | 7 | 10 |
| .1 | 13 | 3 | 6 | 10 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 11 | 1 | 8 | 10 |
| .5 | 12 | 2 | 7 | 10 |
| .1 | 13 | 3 | 6 | 10 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 11 | 1 | 8 | 10 |
| .5 | 12 | 2 | 7 | 10 |
| .1 | 13 | 3 | 6 | 10 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 11 | 1 | 8 | 10 |
| .5 | 12 | 2 | 7 | 10 |
| .1 | 13 | 3 | 6 | 10 |

Consequence: Iso 15 late No 70 (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 23 | 3 | 17 | 20 |
| .5 | 24 | 4 | 16 | 20 |
| .1 | 26 | 6 | 14 | 20 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 23 | 3 | 17 | 20 |
| .5 | 24 | 4 | 16 | 20 |
| .1 | 26 | 6 | 14 | 20 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 23 | 3 | 17 | 20 |
| .5 | 24 | 4 | 16 | 20 |
| .1 | 26 | 6 | 14 | 20 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 23 | 3 | 17 | 20 |
| .5 | 24 | 4 | 16 | 20 |
| .1 | 26 | 6 | 14 | 20 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 23 | 3 | 17 | 20 |
| .5 | 24 | 4 | 16 | 20 |
| .1 | 26 | 6 | 14 | 20 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 12 | 2 | 7 | 9 |
| .5 | 13 | 3 | 7 | 10 |
| .1 | 15 | 5 | 5 | 10 |

Consequence: Iso 15 late No ru (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 48 | 7 | 33 | 40 |
| .5 | 49 | 9 | 31 | 40 |
| .1 | 53 | 13 | 27 | 40 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 35 | 5 | 25 | 30 |
| .5 | 38 | 8 | 22 | 30 |
| .1 | 41 | 11 | 19 | 30 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 56 | 6 | 44 | 50 |
| .5 | 59 | 9 | 41 | 50 |
| .1 | 63 | 13 | 37 | 50 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 35 | 5 | 25 | 30 |
| .5 | 38 | 8 | 22 | 30 |
| .1 | 41 | 11 | 19 | 30 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 48 | 7 | 33 | 40 |
| .5 | 49 | 9 | 31 | 40 |
| .1 | 53 | 13 | 27 | 40 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 35 | 5 | 25 | 30 |
| .5 | 38 | 8 | 22 | 30 |
| .1 | 41 | 11 | 19 | 30 |

Consequence: Iso 15 poolf Man 22 (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 24 | 18 | -13 | 5 |
| .5 | 36 | 30 | -24 | 5 |
| .1 | 56 | 50 | -44 | 6 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 22 | 16 | -11 | 5 |
| .5 | 33 | 26 | -20 | 6 |
| .1 | 51 | 44 | -38 | 6 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 25 | 17 | -12 | 6 |
| .5 | 36 | 29 | -22 | 6 |
| .1 | 54 | 47 | -41 | 6 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 23 | 15 | -10 | 6 |
| .5 | 33 | 25 | -18 | 7 |
| .1 | 49 | 41 | -34 | 7 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 25 | 16 | -11 | 7 |
| .5 | 35 | 26 | -19 | 7 |
| .1 | 51 | 43 | -36 | 7 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 24 | 14 | -9 | 7 |
| .5 | 33 | 23 | -17 | 8 |
| .1 | 47 | 38 | -31 | 7 |

Consequence: Iso 15 poolf Man 70 (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 29 | 22 | -17 | 6 |
| .5 | 44 | 37 | -30 | 6 |
| .1 | 67 | 61 | -55 | 6 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 29 | 21 | -15 | 6 |
| .5 | 43 | 35 | -28 | 7 |
| .1 | 66 | 58 | -51 | 7 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 30 | 22 | -16 | 7 |
| .5 | 44 | 35 | -28 | 7 |
| .1 | 66 | 58 | -51 | 7 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 31 | 21 | -14 | 8 |
| .5 | 43 | 34 | -26 | 8 |
| .1 | 64 | 55 | -46 | 8 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 31 | 21 | -15 | 8 |
| .5 | 43 | 33 | -25 | 8 |
| .1 | 64 | 54 | -46 | 8 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|

| | | | | |
|---|---|---|---|---|
| 1 | 31 | 20 | -14 | 8 |
| .5 | 43 | 32 | -24 | 9 |
| .1 | 62 | 52 | -44 | 9 |

Consequence: Iso 15 poolf Man 7m (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 9 | 5 | -3 | 3 |
| .5 | 13 | 10 | -6 | 3 |
| .1 | 20 | 17 | -13 | 3 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 8 | 4 | -1 | 3 |
| .5 | 12 | 8 | -4 | 3 |
| .1 | 18 | 14 | -10 | 4 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 9 | 5 | -2 | 3 |
| .5 | 13 | 9 | -6 | 3 |
| .1 | 19 | 15 | -12 | 3 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 9 | 4 | 0 | 4 |
| .5 | 13 | 7 | -3 | 4 |
| .1 | 17 | 12 | -8 | 4 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 10 | 5 | -1 | 4 |
| .5 | 13 | 8 | -4 | 4 |
| .1 | 19 | 14 | -10 | 4 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 10 | 4 | 0 | 4 |
| .5 | 12 | 7 | -2 | 5 |
| .1 | 17 | 11 | -7 | 5 |

Consequence: Iso 15 poolf Man ru (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 30 | 23 | -17 | 6 |
| .5 | 45 | 38 | -31 | 6 |
| .1 | 69 | 62 | -57 | 6 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 30 | 22 | -16 | 7 |
| .5 | 45 | 37 | -29 | 7 |
| .1 | 68 | 60 | -53 | 7 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 31 | 22 | -16 | 7 |
| .5 | 45 | 36 | -29 | 8 |
| .1 | 68 | 60 | -52 | 7 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 32 | 22 | -15 | 8 |
| .5 | 45 | 35 | -27 | 9 |
| .1 | 67 | 57 | -48 | 9 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 32 | 22 | -15 | 8 |
| .5 | 45 | 34 | -26 | 9 |
| .1 | 66 | 56 | -47 | 9 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 32 | 21 | -15 | 8 |
| .5 | 44 | 34 | -25 | 9 |
| .1 | 65 | 54 | -46 | 9 |

Consequence: Iso 15 poolf No 22 (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 24 | 18 | -13 | 5 |
| .5 | 36 | 30 | -24 | 5 |
| .1 | 56 | 50 | -44 | 6 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 22 | 16 | -11 | 5 |
| .5 | 33 | 26 | -20 | 6 |
| .1 | 51 | 44 | -38 | 6 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 25 | 17 | -12 | 6 |
| .5 | 36 | 29 | -22 | 6 |
| .1 | 54 | 47 | -41 | 6 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 23 | 15 | -10 | 6 |
| .5 | 33 | 25 | -18 | 7 |
| .1 | 49 | 41 | -34 | 7 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|

| | | | | |
|---|---|---|---|---|
| 1 | 25 | 16 | -11 | 7 |
| .5 | 35 | 26 | -19 | 7 |
| .1 | 51 | 43 | -36 | 7 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 22 | 16 | -11 | 5 |
| .5 | 33 | 26 | -20 | 6 |
| .1 | 51 | 44 | -38 | 6 |

Consequence: Iso 15 poolf No 70 (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 27 | 21 | -15 | 5 |
| .5 | 41 | 34 | -28 | 6 |
| .1 | 64 | 57 | -51 | 6 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 28 | 20 | -14 | 6 |
| .5 | 41 | 33 | -26 | 7 |
| .1 | 62 | 55 | -48 | 7 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 28 | 20 | -14 | 6 |
| .5 | 41 | 33 | -26 | 7 |
| .1 | 62 | 54 | -47 | 7 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 29 | 19 | -13 | 7 |
| .5 | 41 | 31 | -24 | 8 |
| .1 | 60 | 51 | -43 | 8 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 29 | 19 | -13 | 7 |
| .5 | 40 | 31 | -23 | 8 |
| .1 | 60 | 51 | -42 | 8 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 28 | 20 | -14 | 6 |
| .5 | 41 | 33 | -26 | 7 |
| .1 | 62 | 55 | -48 | 7 |

Consequence: Iso 15 poolf No 7m (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 9 | 5 | -3 | 3 |
| .5 | 13 | 10 | -6 | 3 |
| .1 | 20 | 17 | -13 | 3 |

Weather state: 2.5B

Fatality

| prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 8 | 4 | -1 | 3 |
| .5 | 12 | 8 | -4 | 3 |
| .1 | 18 | 14 | -10 | 4 |

Weather state: 3.0F

Fatality

| prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 9 | 5 | -2 | 3 |
| .5 | 13 | 9 | -6 | 3 |
| .1 | 19 | 15 | -12 | 3 |

Weather state: 4.2C

Fatality

| prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 9 | 4 | 0 | 4 |
| .5 | 13 | 7 | -3 | 4 |
| .1 | 17 | 12 | -8 | 4 |

Weather state: 5.1D

Fatality

| prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 10 | 5 | -1 | 4 |
| .5 | 13 | 8 | -4 | 4 |
| .1 | 19 | 14 | -10 | 4 |

Weather state: 6.3C

Fatality

| prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 8 | 4 | -1 | 3 |
| .5 | 12 | 8 | -4 | 3 |
| .1 | 18 | 14 | -10 | 4 |

Consequence: Iso 15 poolf No ru (unaffected by topography)

Weather state: 1.8F

Fatality

| prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 28 | 21 | -16 | 6 |
| .5 | 42 | 35 | -29 | 6 |
| .1 | 65 | 59 | -52 | 6 |

Weather state: 2.5B

Fatality

| prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 29 | 21 | -15 | 6 |
| .5 | 42 | 34 | -27 | 7 |
| .1 | 64 | 56 | -49 | 7 |

Weather state: 3.0F

Fatality

| prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 29 | 21 | -15 | 7 |
| .5 | 42 | 34 | -27 | 7 |
| .1 | 64 | 56 | -49 | 7 |

Weather state: 4.2C

Fatality

| prob | d | c | s | m |
|---|---|---|---|---|

| | | | | |
|---|---|---|---|---|
| 1 | 30 | 20 | -14 | 8 |
| .5 | 42 | 33 | -25 | 8 |
| .1 | 63 | 54 | -45 | 9 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 30 | 20 | -14 | 8 |
| .5 | 42 | 32 | -24 | 8 |
| .1 | 62 | 52 | -44 | 9 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 29 | 21 | -15 | 6 |
| .5 | 42 | 34 | -27 | 7 |
| .1 | 64 | 56 | -49 | 7 |

Consequence: Iso 16 BLEVE Man ru (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 0 | 0 | 0 | 0 |
| .5 | 0 | 0 | 0 | 0 |
| .1 | 0 | 0 | 0 | 0 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 0 | 0 | 0 | 0 |
| .5 | 0 | 0 | 0 | 0 |
| .1 | 0 | 0 | 0 | 0 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 0 | 0 | 0 | 0 |
| .5 | 0 | 0 | 0 | 0 |
| .1 | 0 | 0 | 0 | 0 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 0 | 0 | 0 | 0 |
| .5 | 0 | 0 | 0 | 0 |
| .1 | 0 | 0 | 0 | 0 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 0 | 0 | 0 | 0 |
| .5 | 0 | 0 | 0 | 0 |
| .1 | 0 | 0 | 0 | 0 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 0 | 0 | 0 | 0 |
| .5 | 0 | 0 | 0 | 0 |
| .1 | 0 | 0 | 0 | 0 |

Consequence: Iso 16 BLEVE No ru (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 0 | 0 | 0 | 0 |
| .5 | 0 | 0 | 0 | 0 |
| .1 | 0 | 0 | 0 | 0 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 0 | 0 | 0 | 0 |
| .5 | 0 | 0 | 0 | 0 |
| .1 | 0 | 0 | 0 | 0 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 0 | 0 | 0 | 0 |
| .5 | 0 | 0 | 0 | 0 |
| .1 | 0 | 0 | 0 | 0 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 0 | 0 | 0 | 0 |
| .5 | 0 | 0 | 0 | 0 |
| .1 | 0 | 0 | 0 | 0 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 0 | 0 | 0 | 0 |
| .5 | 0 | 0 | 0 | 0 |
| .1 | 0 | 0 | 0 | 0 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 0 | 0 | 0 | 0 |
| .5 | 0 | 0 | 0 | 0 |
| .1 | 0 | 0 | 0 | 0 |

Consequence: Iso 16 late Man 22 (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 13 | 3 | 7 | 10 |
| .5 | 14 | 4 | 6 | 10 |
| .1 | 15 | 5 | 4 | 10 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 13 | 3 | 7 | 10 |
| .5 | 14 | 4 | 6 | 10 |
| .1 | 15 | 5 | 4 | 10 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|

| | | | | |
|---|---|---|---|---|
| 1 | 13 | 3 | 7 | 10 |
| .5 | 14 | 4 | 6 | 10 |
| .1 | 15 | 5 | 4 | 10 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 0 | 0 | 0 | 0 | 0 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 0 | 0 | 0 | 0 | 0 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 0 | 0 | 0 | 0 | 0 |

Consequence: Iso 16 late Man 70 (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 34 | 4 | 26 | 30 |
| .5 | 36 | 6 | 24 | 30 |
| .1 | 38 | 8 | 21 | 29 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 34 | 4 | 26 | 30 |
| .5 | 36 | 6 | 24 | 30 |
| .1 | 38 | 8 | 21 | 29 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 34 | 4 | 26 | 30 |
| .5 | 36 | 6 | 24 | 30 |
| .1 | 38 | 8 | 21 | 29 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 34 | 4 | 26 | 30 |
| .5 | 36 | 6 | 24 | 30 |
| .1 | 38 | 8 | 21 | 29 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 34 | 4 | 26 | 30 |
| .5 | 36 | 6 | 24 | 30 |
| .1 | 38 | 8 | 21 | 29 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 34 | 4 | 26 | 30 |
| .5 | 36 | 6 | 24 | 30 |

| | | | | |
|---|---|---|---|---|
| .1 | 38 | 8 | 21 | 29 |

Consequence: Iso 16 late Man ru (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 58 | 8 | 42 | 50 |
| .5 | 61 | 12 | 37 | 49 |
| .1 | 65 | 15 | 35 | 50 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 78 | 8 | 62 | 70 |
| .5 | 82 | 12 | 58 | 70 |
| .1 | 86 | 16 | 54 | 70 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 68 | 8 | 52 | 60 |
| .5 | 71 | 11 | 49 | 60 |
| .1 | 75 | 15 | 45 | 60 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 88 | 8 | 72 | 80 |
| .5 | 92 | 12 | 68 | 80 |
| .1 | 97 | 17 | 63 | 80 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 78 | 8 | 62 | 70 |
| .5 | 82 | 12 | 58 | 70 |
| .1 | 86 | 16 | 54 | 70 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 88 | 8 | 72 | 80 |
| .5 | 92 | 12 | 68 | 80 |
| .1 | 97 | 17 | 63 | 80 |

Consequence: Iso 16 late No 22 (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 13 | 3 | 7 | 10 |
| .5 | 14 | 4 | 6 | 10 |
| .1 | 15 | 5 | 4 | 10 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 13 | 3 | 7 | 10 |
| .5 | 14 | 4 | 6 | 10 |
| .1 | 15 | 5 | 4 | 10 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 13 | 3 | 7 | 10 |
| .5 | 14 | 4 | 6 | 10 |
| .1 | 15 | 5 | 4 | 10 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 0 | 0 | 0 | 0 | 0 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 0 | 0 | 0 | 0 | 0 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 0 | 0 | 0 | 0 | 0 |

Consequence: Iso 16 late No 70 (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 34 | 4 | 26 | 30 |
| .5 | 36 | 6 | 24 | 30 |
| .1 | 38 | 8 | 21 | 29 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 34 | 4 | 26 | 30 |
| .5 | 36 | 6 | 24 | 30 |
| .1 | 38 | 8 | 21 | 29 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 34 | 4 | 26 | 30 |
| .5 | 36 | 6 | 24 | 30 |
| .1 | 38 | 8 | 21 | 29 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 34 | 4 | 26 | 30 |
| .5 | 36 | 6 | 24 | 30 |
| .1 | 38 | 8 | 21 | 29 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 34 | 4 | 26 | 30 |
| .5 | 36 | 6 | 24 | 30 |
| .1 | 38 | 8 | 21 | 29 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 34 | 4 | 26 | 30 |
| .5 | 36 | 6 | 24 | 30 |
| .1 | 38 | 8 | 21 | 29 |

Consequence: Iso 16 late No ru (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 58 | 8 | 42 | 50 |
| .5 | 61 | 12 | 37 | 49 |
| .1 | 65 | 15 | 35 | 50 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 78 | 8 | 62 | 70 |
| .5 | 82 | 12 | 58 | 70 |
| .1 | 86 | 16 | 54 | 70 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 68 | 8 | 52 | 60 |
| .5 | 71 | 11 | 49 | 60 |
| .1 | 75 | 15 | 45 | 60 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 88 | 8 | 72 | 80 |
| .5 | 92 | 12 | 68 | 80 |
| .1 | 97 | 17 | 63 | 80 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 78 | 8 | 62 | 70 |
| .5 | 82 | 12 | 58 | 70 |
| .1 | 86 | 16 | 54 | 70 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 88 | 8 | 72 | 80 |
| .5 | 92 | 12 | 68 | 80 |
| .1 | 97 | 17 | 63 | 80 |

Consequence: Iso 16 poolf Man 22 (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 30 | 19 | -10 | 10 |
| .5 | 43 | 33 | -22 | 10 |
| .1 | 65 | 54 | -44 | 10 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 31 | 19 | -8 | 11 |
| .5 | 43 | 31 | -19 | 12 |

| | | | | |
|---|---|---|---|---|
| .1 | 63 | 51 | -39 | 11 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 31 | 19 | -9 | 11 |
| .5 | 43 | 31 | -20 | 11 |
| .1 | 63 | 51 | -40 | 11 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 32 | 18 | -7 | 12 |
| .5 | 43 | 29 | -17 | 13 |
| .1 | 62 | 48 | -35 | 13 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 32 | 18 | -8 | 12 |
| .5 | 43 | 29 | -17 | 12 |
| .1 | 62 | 48 | -35 | 13 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 33 | 17 | -7 | 13 |
| .5 | 43 | 28 | -16 | 13 |
| .1 | 60 | 46 | -33 | 13 |

Consequence: Iso 16 poolf Man 70 (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 33 | 20 | -8 | 12 |
| .5 | 47 | 34 | -21 | 13 |
| .1 | 69 | 56 | -43 | 12 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 35 | 20 | -7 | 13 |
| .5 | 47 | 33 | -19 | 14 |
| .1 | 68 | 54 | -40 | 14 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 34 | 20 | -7 | 13 |
| .5 | 47 | 32 | -18 | 14 |
| .1 | 68 | 53 | -39 | 14 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 35 | 19 | -6 | 14 |
| .5 | 47 | 31 | -17 | 15 |
| .1 | 67 | 51 | -36 | 15 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 36 | 19 | -6 | 15 |
| .5 | 48 | 31 | -16 | 16 |
| .1 | 67 | 50 | -34 | 16 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 37 | 19 | -5 | 15 |
| .5 | 47 | 30 | -15 | 16 |
| .1 | 65 | 49 | -33 | 15 |

Consequence: Iso 16 poolf Man 7m (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 20 | 12 | -5 | 7 |
| .5 | 28 | 20 | -13 | 7 |
| .1 | 42 | 34 | -26 | 7 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 18 | 10 | -4 | 7 |
| .5 | 25 | 17 | -10 | 7 |
| .1 | 37 | 29 | -22 | 7 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 20 | 11 | -4 | 7 |
| .5 | 28 | 19 | -11 | 8 |
| .1 | 40 | 32 | -24 | 8 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 19 | 10 | -3 | 8 |
| .5 | 25 | 16 | -8 | 8 |
| .1 | 36 | 27 | -19 | 8 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 21 | 11 | -3 | 8 |
| .5 | 27 | 18 | -9 | 9 |
| .1 | 39 | 29 | -20 | 9 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 20 | 9 | -2 | 9 |
| .5 | 26 | 15 | -7 | 9 |
| .1 | 35 | 25 | -16 | 9 |

Consequence: Iso 16 poolf Man ru (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 39 | 21 | -3 | 17 |
| .5 | 52 | 34 | -17 | 17 |

| | | | | |
|---|---|---|---|---|
| .1 | 75 | 57 | -39 | 17 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 40 | 20 | -3 | 18 |
| .5 | 53 | 33 | -15 | 19 |
| .1 | 75 | 55 | -36 | 19 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 39 | 20 | -3 | 17 |
| .5 | 52 | 33 | -15 | 18 |
| .1 | 73 | 54 | -36 | 18 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 42 | 20 | -1 | 20 |
| .5 | 54 | 32 | -12 | 20 |
| .1 | 74 | 52 | -31 | 21 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 42 | 20 | -1 | 20 |
| .5 | 53 | 31 | -11 | 20 |
| .1 | 73 | 51 | -31 | 20 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 44 | 19 | 0 | 22 |
| .5 | 55 | 31 | -9 | 23 |
| .1 | 74 | 50 | -27 | 23 |

Consequence: Iso 16 poolf No 22 (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 30 | 19 | -10 | 10 |
| .5 | 43 | 33 | -22 | 10 |
| .1 | 65 | 54 | -44 | 10 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 31 | 19 | -8 | 11 |
| .5 | 43 | 31 | -19 | 12 |
| .1 | 63 | 51 | -39 | 11 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 31 | 19 | -9 | 11 |
| .5 | 43 | 31 | -20 | 11 |
| .1 | 63 | 51 | -40 | 11 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 32 | 18 | -7 | 12 |
| .5 | 43 | 29 | -17 | 13 |
| .1 | 62 | 48 | -35 | 13 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 32 | 18 | -8 | 12 |
| .5 | 43 | 29 | -17 | 12 |
| .1 | 62 | 48 | -35 | 13 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 31 | 19 | -8 | 11 |
| .5 | 43 | 31 | -19 | 12 |
| .1 | 63 | 51 | -39 | 11 |

Consequence: Iso 16 poolf No 70 (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 33 | 20 | -8 | 12 |
| .5 | 47 | 34 | -21 | 13 |
| .1 | 69 | 56 | -43 | 12 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 35 | 20 | -7 | 13 |
| .5 | 47 | 33 | -19 | 14 |
| .1 | 68 | 54 | -40 | 14 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 34 | 20 | -7 | 13 |
| .5 | 47 | 32 | -18 | 14 |
| .1 | 68 | 53 | -39 | 14 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 35 | 19 | -6 | 14 |
| .5 | 47 | 31 | -17 | 15 |
| .1 | 67 | 51 | -36 | 15 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 36 | 19 | -6 | 15 |
| .5 | 48 | 31 | -16 | 16 |
| .1 | 67 | 50 | -34 | 16 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 35 | 20 | -7 | 13 |
| .5 | 47 | 33 | -19 | 14 |
| .1 | 68 | 54 | -40 | 14 |

Consequence: Iso 16 poolf No 7m (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 20 | 12 | -5 | 7 |
| .5 | 28 | 20 | -13 | 7 |
| .1 | 42 | 34 | -26 | 7 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 18 | 10 | -4 | 7 |
| .5 | 25 | 17 | -10 | 7 |
| .1 | 37 | 29 | -22 | 7 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 20 | 11 | -4 | 7 |
| .5 | 28 | 19 | -11 | 8 |
| .1 | 40 | 32 | -24 | 8 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 19 | 10 | -3 | 8 |
| .5 | 25 | 16 | -8 | 8 |
| .1 | 36 | 27 | -19 | 8 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 21 | 11 | -3 | 8 |
| .5 | 27 | 18 | -9 | 9 |
| .1 | 39 | 29 | -20 | 9 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 18 | 10 | -4 | 7 |
| .5 | 25 | 17 | -10 | 7 |
| .1 | 37 | 29 | -22 | 7 |

Consequence: Iso 16 poolf No ru (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 39 | 21 | -3 | 17 |
| .5 | 52 | 34 | -17 | 17 |
| .1 | 75 | 57 | -39 | 17 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 40 | 20 | -3 | 18 |
| .5 | 53 | 33 | -15 | 19 |
| .1 | 75 | 55 | -36 | 19 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 39 | 20 | -3 | 17 |
| .5 | 52 | 33 | -15 | 18 |
| .1 | 73 | 54 | -36 | 18 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 42 | 20 | -1 | 20 |
| .5 | 54 | 32 | -12 | 20 |
| .1 | 74 | 52 | -31 | 21 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 42 | 20 | -1 | 20 |
| .5 | 53 | 31 | -11 | 20 |
| .1 | 73 | 51 | -31 | 20 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 40 | 20 | -3 | 18 |
| .5 | 53 | 33 | -15 | 19 |
| .1 | 75 | 55 | -36 | 19 |

Consequence: Iso 17 poolf Man 22 (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 9 | 5 | -3 | 2 |
| .5 | 13 | 10 | -6 | 3 |
| .1 | 20 | 17 | -13 | 3 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 8 | 4 | -1 | 3 |
| .5 | 12 | 8 | -4 | 3 |
| .1 | 18 | 13 | -9 | 4 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 9 | 5 | -2 | 3 |
| .5 | 13 | 9 | -6 | 3 |
| .1 | 19 | 15 | -12 | 3 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 9 | 4 | 0 | 4 |
| .5 | 12 | 7 | -3 | 4 |
| .1 | 17 | 12 | -8 | 4 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 10 | 5 | -1 | 4 |
| .5 | 13 | 8 | -4 | 4 |
| .1 | 19 | 13 | -9 | 4 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 10 | 4 | 0 | 4 |
| .5 | 12 | 7 | -2 | 5 |
| .1 | 17 | 11 | -7 | 5 |

Consequence: Iso 17 poolf Man 70 (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 9 | 5 | -3 | 2 |
| .5 | 13 | 10 | -6 | 3 |
| .1 | 20 | 17 | -13 | 3 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 8 | 4 | -1 | 3 |
| .5 | 12 | 8 | -4 | 3 |
| .1 | 18 | 13 | -9 | 4 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 9 | 5 | -2 | 3 |
| .5 | 13 | 9 | -6 | 3 |
| .1 | 19 | 15 | -12 | 3 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 9 | 4 | 0 | 4 |
| .5 | 12 | 7 | -3 | 4 |
| .1 | 17 | 12 | -8 | 4 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 10 | 5 | -1 | 4 |
| .5 | 13 | 8 | -4 | 4 |
| .1 | 19 | 13 | -9 | 4 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 10 | 4 | 0 | 4 |
| .5 | 12 | 7 | -2 | 5 |
| .1 | 17 | 11 | -7 | 5 |

Consequence: Iso 17 poolf Man 7m (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 9 | 5 | -3 | 2 |
| .5 | 13 | 10 | -6 | 3 |
| .1 | 20 | 17 | -13 | 3 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 8 | 4 | -1 | 3 |
| .5 | 12 | 8 | -4 | 3 |
| .1 | 18 | 13 | -9 | 4 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 9 | 5 | -2 | 3 |
| .5 | 13 | 9 | -6 | 3 |
| .1 | 19 | 15 | -12 | 3 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 9 | 4 | 0 | 4 |
| .5 | 12 | 7 | -3 | 4 |
| .1 | 17 | 12 | -8 | 4 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 10 | 5 | -1 | 4 |
| .5 | 13 | 8 | -4 | 4 |
| .1 | 19 | 13 | -9 | 4 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 10 | 4 | 0 | 4 |
| .5 | 12 | 7 | -2 | 5 |
| .1 | 17 | 11 | -7 | 5 |

Consequence: Iso 17 poolf Man ru (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 9 | 5 | -3 | 2 |
| .5 | 13 | 10 | -6 | 3 |
| .1 | 20 | 17 | -13 | 3 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 8 | 4 | -1 | 3 |
| .5 | 12 | 8 | -4 | 3 |
| .1 | 18 | 13 | -9 | 4 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 9 | 5 | -2 | 3 |
| .5 | 13 | 9 | -6 | 3 |
| .1 | 19 | 15 | -12 | 3 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 9 | 4 | 0 | 4 |
| .5 | 12 | 7 | -3 | 4 |
| .1 | 17 | 12 | -8 | 4 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 10 | 5 | -1 | 4 |
| .5 | 13 | 8 | -4 | 4 |
| .1 | 19 | 13 | -9 | 4 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 10 | 4 | 0 | 4 |
| .5 | 12 | 7 | -2 | 5 |
| .1 | 17 | 11 | -7 | 5 |

Consequence: Iso 17 poolf No 22 (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 9 | 5 | -3 | 2 |
| .5 | 13 | 10 | -6 | 3 |
| .1 | 20 | 17 | -13 | 3 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 8 | 4 | -1 | 3 |
| .5 | 12 | 8 | -4 | 3 |
| .1 | 18 | 13 | -9 | 4 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 9 | 5 | -2 | 3 |
| .5 | 13 | 9 | -6 | 3 |
| .1 | 19 | 15 | -12 | 3 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 9 | 4 | 0 | 4 |
| .5 | 12 | 7 | -3 | 4 |
| .1 | 17 | 12 | -8 | 4 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 10 | 5 | -1 | 4 |
| .5 | 13 | 8 | -4 | 4 |
| .1 | 19 | 13 | -9 | 4 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 10 | 4 | 0 | 4 |
| .5 | 12 | 7 | -2 | 5 |
| .1 | 17 | 11 | -7 | 5 |

Consequence: Iso 17 poolf No 70 (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 9 | 5 | -3 | 2 |
| .5 | 13 | 10 | -6 | 3 |
| .1 | 20 | 17 | -13 | 3 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 8 | 4 | -1 | 3 |
| .5 | 12 | 8 | -4 | 3 |
| .1 | 18 | 13 | -9 | 4 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 9 | 5 | -2 | 3 |
| .5 | 13 | 9 | -6 | 3 |
| .1 | 19 | 15 | -12 | 3 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 9 | 4 | 0 | 4 |
| .5 | 12 | 7 | -3 | 4 |
| .1 | 17 | 12 | -8 | 4 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 10 | 5 | -1 | 4 |
| .5 | 13 | 8 | -4 | 4 |
| .1 | 19 | 13 | -9 | 4 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 10 | 4 | 0 | 4 |
| .5 | 12 | 7 | -2 | 5 |
| .1 | 17 | 11 | -7 | 5 |

Consequence: Iso 17 poolf No 7m (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 9 | 5 | -3 | 2 |
| .5 | 13 | 10 | -6 | 3 |
| .1 | 20 | 17 | -13 | 3 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 8 | 4 | -1 | 3 |
| .5 | 12 | 8 | -4 | 3 |
| .1 | 18 | 13 | -9 | 4 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 9 | 5 | -2 | 3 |
| .5 | 13 | 9 | -6 | 3 |
| .1 | 19 | 15 | -12 | 3 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 9 | 4 | 0 | 4 |
| .5 | 12 | 7 | -3 | 4 |
| .1 | 17 | 12 | -8 | 4 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 10 | 5 | -1 | 4 |
| .5 | 13 | 8 | -4 | 4 |
| .1 | 19 | 13 | -9 | 4 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 10 | 4 | 0 | 4 |
| .5 | 12 | 7 | -2 | 5 |
| .1 | 17 | 11 | -7 | 5 |

Consequence: Iso 17 poolf No ru (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 9 | 5 | -3 | 2 |
| .5 | 13 | 10 | -6 | 3 |
| .1 | 20 | 17 | -13 | 3 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 8 | 4 | -1 | 3 |
| .5 | 12 | 8 | -4 | 3 |
| .1 | 18 | 13 | -9 | 4 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 9 | 5 | -2 | 3 |
| .5 | 13 | 9 | -6 | 3 |
| .1 | 19 | 15 | -12 | 3 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 9 | 4 | 0 | 4 |
| .5 | 12 | 7 | -3 | 4 |
| .1 | 17 | 12 | -8 | 4 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 10 | 5 | -1 | 4 |
| .5 | 13 | 8 | -4 | 4 |
| .1 | 19 | 13 | -9 | 4 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|

| | | | | |
|---|---|---|---|---|
| 1 | 10 | 4 | 0 | 4 |
| .5 | 12 | 7 | -2 | 5 |
| .1 | 17 | 11 | -7 | 5 |

Consequence: Iso 18 "idl late Man 22 (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 11 | 1 | 8 | 10 |
| .5 | 12 | 2 | 8 | 10 |
| .1 | 13 | 3 | 7 | 10 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 11 | 1 | 8 | 10 |
| .5 | 12 | 2 | 8 | 10 |
| .1 | 13 | 3 | 7 | 10 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 11 | 1 | 8 | 10 |
| .5 | 12 | 2 | 8 | 10 |
| .1 | 13 | 3 | 7 | 10 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 11 | 1 | 8 | 10 |
| .5 | 12 | 2 | 8 | 10 |
| .1 | 13 | 3 | 7 | 10 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 11 | 1 | 8 | 10 |
| .5 | 12 | 2 | 8 | 10 |
| .1 | 13 | 3 | 7 | 10 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 11 | 1 | 8 | 10 |
| .5 | 12 | 2 | 8 | 10 |
| .1 | 13 | 3 | 7 | 10 |

Consequence: Iso 18 "idl late Man 70 (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 49 | 9 | 31 | 40 |
| .5 | 53 | 13 | 27 | 40 |
| .1 | 58 | 18 | 22 | 40 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 23 | 3 | 17 | 20 |
| .5 | 25 | 5 | 15 | 20 |
| .1 | 28 | 7 | 13 | 20 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 37 | 7 | 23 | 30 |
| .5 | 40 | 10 | 20 | 30 |
| .1 | 43 | 13 | 17 | 30 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 23 | 3 | 17 | 20 |
| .5 | 25 | 5 | 15 | 20 |
| .1 | 28 | 7 | 13 | 20 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 13 | 3 | 7 | 10 |
| .5 | 14 | 4 | 6 | 10 |
| .1 | 16 | 6 | 4 | 10 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 13 | 3 | 7 | 10 |
| .5 | 14 | 4 | 6 | 10 |
| .1 | 16 | 6 | 4 | 10 |

Consequence: Iso 18 "idl late Man ru (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 67 | 17 | 33 | 50 |
| .5 | 75 | 25 | 25 | 50 |
| .1 | 85 | 35 | 15 | 50 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 40 | 10 | 20 | 30 |
| .5 | 45 | 15 | 15 | 30 |
| .1 | 52 | 22 | 8 | 30 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 38 | 8 | 22 | 30 |
| .5 | 42 | 12 | 18 | 30 |
| .1 | 47 | 17 | 13 | 30 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 27 | 7 | 13 | 20 |
| .5 | 30 | 10 | 10 | 20 |
| .1 | 35 | 15 | 5 | 20 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|

| | | | | |
|---|---|---|---|---|
| 1 | 26 | 6 | 14 | 20 |
| .5 | 29 | 9 | 11 | 20 |
| .1 | 33 | 13 | 7 | 20 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 26 | 6 | 14 | 20 |
| .5 | 29 | 9 | 11 | 20 |
| .1 | 33 | 13 | 7 | 20 |

Consequence: Iso 18 "idl late No 22 (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 11 | 1 | 8 | 10 |
| .5 | 12 | 2 | 8 | 10 |
| .1 | 13 | 3 | 7 | 10 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 11 | 1 | 8 | 10 |
| .5 | 12 | 2 | 8 | 10 |
| .1 | 13 | 3 | 7 | 10 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 11 | 1 | 8 | 10 |
| .5 | 12 | 2 | 8 | 10 |
| .1 | 13 | 3 | 7 | 10 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 11 | 1 | 8 | 10 |
| .5 | 12 | 2 | 8 | 10 |
| .1 | 13 | 3 | 7 | 10 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 11 | 1 | 8 | 10 |
| .5 | 12 | 2 | 8 | 10 |
| .1 | 13 | 3 | 7 | 10 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 11 | 1 | 8 | 10 |
| .5 | 12 | 2 | 8 | 10 |
| .1 | 13 | 3 | 7 | 10 |

Consequence: Iso 18 "idl late No 70 (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 49 | 9 | 31 | 40 |
| .5 | 53 | 13 | 27 | 40 |
| .1 | 58 | 18 | 22 | 40 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 23 | 3 | 17 | 20 |
| .5 | 25 | 5 | 15 | 20 |
| .1 | 28 | 7 | 13 | 20 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 37 | 7 | 23 | 30 |
| .5 | 40 | 10 | 20 | 30 |
| .1 | 43 | 13 | 17 | 30 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 23 | 3 | 17 | 20 |
| .5 | 25 | 5 | 15 | 20 |
| .1 | 28 | 7 | 13 | 20 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 13 | 3 | 7 | 10 |
| .5 | 14 | 4 | 6 | 10 |
| .1 | 16 | 6 | 4 | 10 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 13 | 3 | 7 | 10 |
| .5 | 14 | 4 | 6 | 10 |
| .1 | 16 | 6 | 4 | 10 |

Consequence: Iso 18 "idl late No ru (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 67 | 17 | 33 | 50 |
| .5 | 75 | 25 | 25 | 50 |
| .1 | 85 | 35 | 15 | 50 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 40 | 10 | 20 | 30 |
| .5 | 45 | 15 | 15 | 30 |
| .1 | 52 | 22 | 8 | 30 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 38 | 8 | 22 | 30 |
| .5 | 42 | 12 | 18 | 30 |
| .1 | 47 | 17 | 13 | 30 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|

| | | | | |
|---|---|---|---|---|
| 1 | 27 | 7 | 13 | 20 |
| .5 | 30 | 10 | 10 | 20 |
| .1 | 35 | 15 | 5 | 20 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 26 | 6 | 14 | 20 |
| .5 | 29 | 9 | 11 | 20 |
| .1 | 33 | 13 | 7 | 20 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 26 | 6 | 14 | 20 |
| .5 | 29 | 9 | 11 | 20 |
| .1 | 33 | 13 | 7 | 20 |

Consequence: Iso 18 "idl poolf Man 22 (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 24 | 18 | -13 | 5 |
| .5 | 36 | 30 | -24 | 5 |
| .1 | 56 | 50 | -44 | 6 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 22 | 16 | -11 | 5 |
| .5 | 33 | 26 | -20 | 6 |
| .1 | 50 | 44 | -38 | 6 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 24 | 17 | -12 | 6 |
| .5 | 35 | 28 | -22 | 6 |
| .1 | 54 | 47 | -41 | 6 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 23 | 15 | -10 | 6 |
| .5 | 33 | 25 | -18 | 7 |
| .1 | 48 | 41 | -33 | 7 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 25 | 16 | -11 | 7 |
| .5 | 35 | 26 | -19 | 7 |
| .1 | 51 | 43 | -35 | 7 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 24 | 14 | -9 | 7 |
| .5 | 32 | 23 | -16 | 7 |
| .1 | 46 | 38 | -31 | 7 |

Consequence: Iso 18 "idl poolf Man 70 (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 63 | 53 | -45 | 8 |
| .5 | 95 | 85 | -76 | 9 |
| .1 | 147 | 138 | -130 | 8 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 59 | 48 | -39 | 10 |
| .5 | 88 | 77 | -67 | 10 |
| .1 | 136 | 125 | -115 | 10 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 65 | 52 | -42 | 11 |
| .5 | 94 | 82 | -71 | 11 |
| .1 | 146 | 132 | -122 | 12 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 62 | 47 | -37 | 12 |
| .5 | 88 | 73 | -61 | 13 |
| .1 | 132 | 118 | -105 | 13 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 66 | 50 | -39 | 13 |
| .5 | 92 | 77 | -64 | 14 |
| .1 | 138 | 123 | -110 | 13 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 62 | 45 | -36 | 13 |
| .5 | 87 | 70 | -56 | 15 |
| .1 | 127 | 111 | -97 | 14 |

Consequence: Iso 18 "idl poolf Man 7m (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 9 | 5 | -3 | 2 |
| .5 | 13 | 10 | -6 | 3 |
| .1 | 20 | 17 | -13 | 3 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 8 | 4 | -1 | 3 |
| .5 | 12 | 8 | -4 | 3 |
| .1 | 18 | 13 | -9 | 4 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|

| | | | | |
|---|---|---|---|---|
| 1 | 9 | 5 | -2 | 3 |
| .5 | 13 | 9 | -6 | 3 |
| .1 | 19 | 15 | -12 | 3 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 9 | 4 | 0 | 4 |
| .5 | 12 | 7 | -3 | 4 |
| .1 | 17 | 12 | -8 | 4 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 10 | 5 | -1 | 4 |
| .5 | 13 | 8 | -4 | 4 |
| .1 | 19 | 13 | -9 | 4 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 10 | 4 | 0 | 4 |
| .5 | 12 | 7 | -2 | 5 |
| .1 | 17 | 11 | -7 | 5 |

Consequence: Iso 18 "idl poolf Man ru (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 156 | 142 | -130 | 12 |
| .5 | 229 | 216 | -203 | 13 |
| .1 | 355 | 341 | -328 | 13 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 147 | 130 | -116 | 15 |
| .5 | 217 | 197 | -181 | 17 |
| .1 | 327 | 312 | -296 | 15 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 160 | 140 | -123 | 18 |
| .5 | 231 | 210 | -193 | 19 |
| .1 | 352 | 332 | -312 | 19 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 153 | 127 | -108 | 22 |
| .5 | 215 | 190 | -169 | 23 |
| .1 | 320 | 299 | -278 | 20 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 162 | 135 | -115 | 23 |
| .5 | 228 | 200 | -176 | 26 |
| .1 | 340 | 313 | -290 | 25 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 154 | 124 | -105 | 24 |
| .5 | 214 | 184 | -158 | 27 |
| .1 | 313 | 285 | -261 | 25 |

Consequence: Iso 18 "idl poolf No 22 (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 24 | 18 | -13 | 5 |
| .5 | 36 | 30 | -24 | 5 |
| .1 | 56 | 50 | -44 | 6 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 22 | 16 | -11 | 5 |
| .5 | 33 | 26 | -20 | 6 |
| .1 | 50 | 44 | -38 | 6 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 24 | 17 | -12 | 6 |
| .5 | 35 | 28 | -22 | 6 |
| .1 | 54 | 47 | -41 | 6 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 23 | 15 | -10 | 6 |
| .5 | 33 | 25 | -18 | 7 |
| .1 | 48 | 41 | -33 | 7 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 25 | 16 | -11 | 7 |
| .5 | 35 | 26 | -19 | 7 |
| .1 | 51 | 43 | -35 | 7 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 24 | 14 | -9 | 7 |
| .5 | 32 | 23 | -16 | 7 |
| .1 | 46 | 38 | -31 | 7 |

Consequence: Iso 18 "idl poolf No 70 (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 63 | 53 | -45 | 8 |
| .5 | 95 | 85 | -76 | 9 |
| .1 | 147 | 138 | -130 | 8 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|

| | | | | |
|---|---|---|---|---|
| 1 | 59 | 48 | -39 | 10 |
| .5 | 88 | 77 | -67 | 10 |
| .1 | 136 | 125 | -115 | 10 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 65 | 52 | -42 | 11 |
| .5 | 94 | 82 | -71 | 11 |
| .1 | 146 | 132 | -122 | 12 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 62 | 47 | -37 | 12 |
| .5 | 88 | 73 | -61 | 13 |
| .1 | 132 | 118 | -105 | 13 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 66 | 50 | -39 | 13 |
| .5 | 92 | 77 | -64 | 14 |
| .1 | 138 | 123 | -110 | 13 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 62 | 45 | -36 | 13 |
| .5 | 87 | 70 | -56 | 15 |
| .1 | 127 | 111 | -97 | 14 |

Consequence: Iso 18 "idl poolf No 7m (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 9 | 5 | -3 | 2 |
| .5 | 13 | 10 | -6 | 3 |
| .1 | 20 | 17 | -13 | 3 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 8 | 4 | -1 | 3 |
| .5 | 12 | 8 | -4 | 3 |
| .1 | 18 | 13 | -9 | 4 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 9 | 5 | -2 | 3 |
| .5 | 13 | 9 | -6 | 3 |
| .1 | 19 | 15 | -12 | 3 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 9 | 4 | 0 | 4 |
| .5 | 12 | 7 | -3 | 4 |
| .1 | 17 | 12 | -8 | 4 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 10 | 5 | -1 | 4 |
| .5 | 13 | 8 | -4 | 4 |
| .1 | 19 | 13 | -9 | 4 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 10 | 4 | 0 | 4 |
| .5 | 12 | 7 | -2 | 5 |
| .1 | 17 | 11 | -7 | 5 |

Consequence: Iso 18 "idl poolf No ru (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 156 | 142 | -130 | 12 |
| .5 | 229 | 216 | -203 | 13 |
| .1 | 355 | 341 | -328 | 13 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 147 | 130 | -116 | 15 |
| .5 | 217 | 197 | -181 | 17 |
| .1 | 327 | 312 | -296 | 15 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 160 | 140 | -123 | 18 |
| .5 | 231 | 210 | -193 | 19 |
| .1 | 352 | 332 | -312 | 19 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 153 | 127 | -108 | 22 |
| .5 | 215 | 190 | -169 | 23 |
| .1 | 320 | 299 | -278 | 20 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 162 | 135 | -115 | 23 |
| .5 | 228 | 200 | -176 | 26 |
| .1 | 340 | 313 | -290 | 25 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 154 | 124 | -105 | 24 |
| .5 | 214 | 184 | -158 | 27 |
| .1 | 313 | 285 | -261 | 25 |

Consequence: Iso 18 "op" late Man 22 (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|

| | | | | |
|---|---|---|---|---|
| 1 | 32 | 2 | 28 | 30 |
| .5 | 33 | 3 | 26 | 30 |
| .1 | 35 | 5 | 25 | 30 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 23 | 3 | 17 | 20 |
| .5 | 24 | 4 | 16 | 20 |
| .1 | 26 | 6 | 14 | 20 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 23 | 3 | 17 | 20 |
| .5 | 24 | 4 | 16 | 20 |
| .1 | 26 | 6 | 14 | 20 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 23 | 3 | 17 | 20 |
| .5 | 24 | 4 | 16 | 20 |
| .1 | 26 | 6 | 14 | 20 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 13 | 3 | 7 | 10 |
| .5 | 14 | 4 | 6 | 10 |
| .1 | 16 | 6 | 4 | 10 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 23 | 3 | 17 | 20 |
| .5 | 24 | 4 | 16 | 20 |
| .1 | 26 | 6 | 14 | 20 |

Consequence: Iso 18 "op" late Man 70 (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 75 | 5 | 65 | 70 |
| .1 | 81 | 6 | 69 | 75 |
| .5 | 78 | 8 | 62 | 70 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 55 | 5 | 45 | 50 |
| .5 | 57 | 7 | 43 | 50 |
| .1 | 59 | 9 | 41 | 50 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 53 | 3 | 47 | 50 |
| .5 | 56 | 6 | 44 | 50 |
| .1 | 58 | 8 | 42 | 50 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 55 | 5 | 45 | 50 |
| .5 | 57 | 7 | 43 | 50 |
| .1 | 59 | 9 | 41 | 50 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 45 | 5 | 35 | 40 |
| .5 | 47 | 7 | 33 | 40 |
| .1 | 49 | 9 | 31 | 40 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 45 | 5 | 35 | 40 |
| .5 | 47 | 7 | 33 | 40 |
| .1 | 49 | 9 | 31 | 40 |

Consequence: Iso 18 "op" late Man ru (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 215 | 25 | 165 | 190 |
| .5 | 227 | 37 | 153 | 190 |
| .1 | 242 | 52 | 138 | 190 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 132 | 12 | 108 | 120 |
| .5 | 140 | 20 | 100 | 120 |
| .1 | 146 | 26 | 94 | 120 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 122 | 12 | 98 | 110 |
| .5 | 128 | 18 | 92 | 110 |
| .1 | 135 | 25 | 85 | 110 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 102 | 12 | 78 | 90 |
| .5 | 108 | 18 | 72 | 90 |
| .1 | 115 | 25 | 65 | 90 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 100 | 10 | 80 | 90 |
| .5 | 106 | 16 | 74 | 90 |
| .1 | 111 | 21 | 69 | 90 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 81 | 11 | 59 | 70 |
| .5 | 88 | 18 | 52 | 70 |

| | | | | |
|---|---|---|---|---|
| .1 | 95 | 25 | 45 | 70 |

Consequence: Iso 18 "op" late No 22 (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 32 | 2 | 28 | 30 |
| .5 | 33 | 3 | 26 | 30 |
| .1 | 35 | 5 | 25 | 30 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 23 | 3 | 17 | 20 |
| .5 | 24 | 4 | 16 | 20 |
| .1 | 26 | 6 | 14 | 20 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 23 | 3 | 17 | 20 |
| .5 | 24 | 4 | 16 | 20 |
| .1 | 26 | 6 | 14 | 20 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 23 | 3 | 17 | 20 |
| .5 | 24 | 4 | 16 | 20 |
| .1 | 26 | 6 | 14 | 20 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 13 | 3 | 7 | 10 |
| .5 | 14 | 4 | 6 | 10 |
| .1 | 16 | 6 | 4 | 10 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 23 | 3 | 17 | 20 |
| .5 | 24 | 4 | 16 | 20 |
| .1 | 26 | 6 | 14 | 20 |

Consequence: Iso 18 "op" late No 70 (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 75 | 5 | 65 | 70 |
| .1 | 81 | 6 | 69 | 75 |
| .5 | 78 | 8 | 62 | 70 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 55 | 5 | 45 | 50 |
| .5 | 57 | 7 | 43 | 50 |
| .1 | 59 | 9 | 41 | 50 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 53 | 3 | 47 | 50 |
| .5 | 56 | 6 | 44 | 50 |
| .1 | 58 | 8 | 42 | 50 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 55 | 5 | 45 | 50 |
| .5 | 57 | 7 | 43 | 50 |
| .1 | 59 | 9 | 41 | 50 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 45 | 5 | 35 | 40 |
| .5 | 47 | 7 | 33 | 40 |
| .1 | 49 | 9 | 31 | 40 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 45 | 5 | 35 | 40 |
| .5 | 47 | 7 | 33 | 40 |
| .1 | 49 | 9 | 31 | 40 |

Consequence: Iso 18 "op" late No ru (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 215 | 25 | 165 | 190 |
| .5 | 227 | 37 | 153 | 190 |
| .1 | 242 | 52 | 138 | 190 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 132 | 12 | 108 | 120 |
| .5 | 140 | 20 | 100 | 120 |
| .1 | 146 | 26 | 94 | 120 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 122 | 12 | 98 | 110 |
| .5 | 128 | 18 | 92 | 110 |
| .1 | 135 | 25 | 85 | 110 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 102 | 12 | 78 | 90 |
| .5 | 108 | 18 | 72 | 90 |
| .1 | 115 | 25 | 65 | 90 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 100 | 10 | 80 | 90 |
| .5 | 106 | 16 | 74 | 90 |

| | | | | |
|---|---|---|---|---|
| .1 | 111 | 21 | 69 | 90 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 81 | 11 | 59 | 70 |
| .5 | 88 | 18 | 52 | 70 |
| .1 | 95 | 25 | 45 | 70 |

Consequence: Iso 18 "op" poolf Man 22 (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 48 | 36 | -24 | 11 |
| .5 | 69 | 58 | -46 | 11 |
| .1 | 107 | 95 | -84 | 11 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 46 | 32 | -20 | 13 |
| .5 | 66 | 52 | -39 | 13 |
| .1 | 99 | 85 | -72 | 13 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 49 | 35 | -22 | 13 |
| .5 | 70 | 56 | -42 | 14 |
| .1 | 105 | 91 | -77 | 13 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 48 | 31 | -18 | 14 |
| .5 | 66 | 49 | -34 | 15 |
| .1 | 96 | 80 | -65 | 15 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 51 | 33 | -20 | 15 |
| .5 | 69 | 52 | -36 | 16 |
| .1 | 100 | 84 | -68 | 16 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 48 | 29 | -17 | 15 |
| .5 | 65 | 47 | -32 | 16 |
| .1 | 93 | 75 | -59 | 16 |

Consequence: Iso 18 "op" poolf Man 70 (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 126 | 106 | -87 | 19 |
| .5 | 183 | 163 | -144 | 19 |
| .1 | 278 | 260 | -242 | 18 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 120 | 97 | -77 | 21 |
| .5 | 173 | 150 | -128 | 22 |
| .1 | 259 | 237 | -216 | 21 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 129 | 104 | -82 | 23 |
| .5 | 184 | 159 | -136 | 24 |
| .1 | 275 | 253 | -230 | 22 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 123 | 95 | -72 | 25 |
| .5 | 173 | 144 | -117 | 27 |
| .1 | 253 | 226 | -203 | 25 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 132 | 100 | -76 | 28 |
| .5 | 182 | 151 | -123 | 29 |
| .1 | 268 | 237 | -210 | 28 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 125 | 92 | -69 | 28 |
| .5 | 170 | 139 | -111 | 29 |
| .1 | 245 | 215 | -189 | 28 |

Consequence: Iso 18 "op" poolf Man 7m (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 20 | 12 | -5 | 7 |
| .5 | 28 | 20 | -12 | 7 |
| .1 | 42 | 34 | -26 | 7 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 18 | 10 | -4 | 7 |
| .5 | 25 | 17 | -10 | 7 |
| .1 | 37 | 29 | -22 | 7 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 20 | 11 | -5 | 7 |
| .5 | 27 | 19 | -11 | 7 |
| .1 | 40 | 32 | -24 | 7 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 19 | 10 | -3 | 8 |
| .5 | 25 | 16 | -8 | 8 |

| | | | | |
|---|---|---|---|---|
| .1 | 36 | 27 | -19 | 8 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 21 | 10 | -3 | 8 |
| .5 | 27 | 18 | -9 | 9 |
| .1 | 38 | 29 | -20 | 9 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 20 | 9 | -2 | 9 |
| .5 | 26 | 15 | -7 | 9 |
| .1 | 35 | 25 | -16 | 9 |

Consequence: Iso 18 "op" poolf Man ru (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 311 | 281 | -254 | 28 |
| .5 | 441 | 412 | -384 | 28 |
| .1 | 659 | 635 | -608 | 25 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 295 | 259 | -227 | 33 |
| .5 | 416 | 380 | -347 | 34 |
| .1 | 616 | 581 | -546 | 34 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 316 | 278 | -243 | 36 |
| .5 | 443 | 405 | -370 | 36 |
| .1 | 660 | 622 | -585 | 37 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 302 | 254 | -214 | 43 |
| .5 | 417 | 371 | -328 | 44 |
| .1 | 611 | 564 | -520 | 45 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 324 | 270 | -225 | 49 |
| .5 | 443 | 390 | -341 | 50 |
| .1 | 644 | 596 | -548 | 47 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 307 | 249 | -205 | 51 |
| .5 | 415 | 359 | -307 | 54 |
| .1 | 594 | 545 | -496 | 49 |

Consequence: Iso 18 "op" poolf No 22 (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 48 | 36 | -24 | 11 |
| .5 | 69 | 58 | -46 | 11 |
| .1 | 107 | 95 | -84 | 11 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 46 | 32 | -20 | 13 |
| .5 | 66 | 52 | -39 | 13 |
| .1 | 99 | 85 | -72 | 13 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 49 | 35 | -22 | 13 |
| .5 | 70 | 56 | -42 | 14 |
| .1 | 105 | 91 | -77 | 13 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 48 | 31 | -18 | 14 |
| .5 | 66 | 49 | -34 | 15 |
| .1 | 96 | 80 | -65 | 15 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 51 | 33 | -20 | 15 |
| .5 | 69 | 52 | -36 | 16 |
| .1 | 100 | 84 | -68 | 16 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 48 | 29 | -17 | 15 |
| .5 | 65 | 47 | -32 | 16 |
| .1 | 93 | 75 | -59 | 16 |

Consequence: Iso 18 "op" poolf No 70 (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 126 | 106 | -87 | 19 |
| .5 | 183 | 163 | -144 | 19 |
| .1 | 278 | 260 | -242 | 18 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 120 | 97 | -77 | 21 |
| .5 | 173 | 150 | -128 | 22 |
| .1 | 259 | 237 | -216 | 21 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 129 | 104 | -82 | 23 |
| .5 | 184 | 159 | -136 | 24 |

| | | | | |
|---|---|---|---|---|
| .1 | 275 | 253 | -230 | 22 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 123 | 95 | -72 | 25 |
| .5 | 173 | 144 | -117 | 27 |
| .1 | 253 | 226 | -203 | 25 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 132 | 100 | -76 | 28 |
| .5 | 182 | 151 | -123 | 29 |
| .1 | 268 | 237 | -210 | 28 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 125 | 92 | -69 | 28 |
| .5 | 170 | 139 | -111 | 29 |
| .1 | 245 | 215 | -189 | 28 |

Consequence: Iso 18 "op" poolf No 7m (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 20 | 12 | -5 | 7 |
| .5 | 28 | 20 | -12 | 7 |
| .1 | 42 | 34 | -26 | 7 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 18 | 10 | -4 | 7 |
| .5 | 25 | 17 | -10 | 7 |
| .1 | 37 | 29 | -22 | 7 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 20 | 11 | -5 | 7 |
| .5 | 27 | 19 | -11 | 7 |
| .1 | 40 | 32 | -24 | 7 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 19 | 10 | -3 | 8 |
| .5 | 25 | 16 | -8 | 8 |
| .1 | 36 | 27 | -19 | 8 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 21 | 10 | -3 | 8 |
| .5 | 27 | 18 | -9 | 9 |
| .1 | 38 | 29 | -20 | 9 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 20 | 9 | -2 | 9 |
| .5 | 26 | 15 | -7 | 9 |
| .1 | 35 | 25 | -16 | 9 |

Consequence: Iso 18 "op" poolf No ru (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 311 | 281 | -254 | 28 |
| .5 | 441 | 412 | -384 | 28 |
| .1 | 659 | 635 | -608 | 25 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 295 | 259 | -227 | 33 |
| .5 | 416 | 380 | -347 | 34 |
| .1 | 616 | 581 | -546 | 34 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 316 | 278 | -243 | 36 |
| .5 | 443 | 405 | -370 | 36 |
| .1 | 660 | 622 | -585 | 37 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 302 | 254 | -214 | 43 |
| .5 | 417 | 371 | -328 | 44 |
| .1 | 611 | 564 | -520 | 45 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 324 | 270 | -225 | 49 |
| .5 | 443 | 390 | -341 | 50 |
| .1 | 644 | 596 | -548 | 47 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 307 | 249 | -205 | 51 |
| .5 | 415 | 359 | -307 | 54 |
| .1 | 594 | 545 | -496 | 49 |

Consequence: Iso 2 jetfi Man 22 (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 19 | 3 | 1 | 10 |
| .5 | 21 | 7 | 0 | 10 |
| .1 | 22 | 15 | -1 | 10 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 19 | 3 | 1 | 10 |
| .5 | 21 | 7 | 0 | 10 |

| | | | | |
|---|---|---|---|---|
| .1 | 22 | 15 | -1 | 10 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 19 | 3 | 1 | 10 |
| .5 | 21 | 7 | 0 | 10 |
| .1 | 22 | 15 | -1 | 10 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 19 | 3 | 1 | 10 |
| .5 | 21 | 7 | 0 | 10 |
| .1 | 22 | 15 | -1 | 10 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 19 | 3 | 1 | 10 |
| .5 | 21 | 7 | 0 | 10 |
| .1 | 22 | 15 | -1 | 10 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 19 | 3 | 1 | 10 |
| .5 | 21 | 7 | 0 | 10 |
| .1 | 22 | 15 | -1 | 10 |

Consequence: Iso 2 jetfi Man 70 (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 61 | 10 | 2 | 31 |
| .5 | 63 | 23 | 0 | 31 |
| .1 | 68 | 47 | -3 | 32 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 61 | 10 | 2 | 32 |
| .5 | 63 | 23 | 0 | 31 |
| .1 | 68 | 46 | -3 | 32 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 61 | 10 | 2 | 31 |
| .5 | 63 | 23 | 0 | 31 |
| .1 | 68 | 47 | -3 | 32 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 61 | 10 | 2 | 32 |
| .5 | 63 | 23 | 0 | 31 |
| .1 | 68 | 46 | -3 | 32 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 61 | 10 | 2 | 31 |
| .5 | 63 | 23 | 0 | 31 |
| .1 | 68 | 47 | -3 | 32 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 61 | 10 | 2 | 32 |
| .5 | 63 | 23 | 0 | 31 |
| .1 | 68 | 46 | -3 | 32 |

Consequence: Iso 2 jetfi Man 7m (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 5 | 0 | 2 | 4 |
| .5 | 6 | 2 | 0 | 3 |
| .1 | 7 | 5 | 0 | 3 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 5 | 0 | 3 | 4 |
| .5 | 6 | 2 | 0 | 3 |
| .1 | 7 | 4 | 0 | 3 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 5 | 0 | 2 | 4 |
| .5 | 6 | 2 | 0 | 3 |
| .1 | 7 | 5 | 0 | 3 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 5 | 0 | 3 | 4 |
| .5 | 6 | 2 | 0 | 3 |
| .1 | 7 | 4 | 0 | 3 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 5 | 0 | 2 | 4 |
| .5 | 6 | 2 | 0 | 3 |
| .1 | 7 | 5 | 0 | 3 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 5 | 0 | 3 | 4 |
| .5 | 6 | 2 | 0 | 3 |
| .1 | 7 | 4 | 0 | 3 |

Consequence: Iso 2 jetfi Man ru (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| .5 | 172 | 66 | -1 | 85 |
| .1 | 187 | 131 | -9 | 89 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| .5 | 172 | 63 | -1 | 85 |
| .1 | 186 | 125 | -9 | 88 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| .5 | 172 | 66 | -1 | 85 |
| .1 | 187 | 131 | -9 | 89 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| .5 | 172 | 63 | -1 | 85 |
| .1 | 186 | 125 | -9 | 88 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| .5 | 172 | 66 | -1 | 85 |
| .1 | 187 | 131 | -9 | 89 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| .5 | 172 | 63 | -1 | 85 |
| .1 | 186 | 125 | -9 | 88 |

Consequence: Iso 2 jetfi No 22 (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 19 | 3 | 1 | 10 |
| .5 | 21 | 7 | 0 | 10 |
| .1 | 22 | 15 | -1 | 10 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 19 | 3 | 1 | 10 |
| .5 | 21 | 7 | 0 | 10 |
| .1 | 22 | 15 | -1 | 10 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 19 | 3 | 1 | 10 |
| .5 | 21 | 7 | 0 | 10 |
| .1 | 22 | 15 | -1 | 10 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 19 | 3 | 1 | 10 |
| .5 | 21 | 7 | 0 | 10 |
| .1 | 22 | 15 | -1 | 10 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 19 | 3 | 1 | 10 |
| .5 | 21 | 7 | 0 | 10 |
| .1 | 22 | 15 | -1 | 10 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 19 | 3 | 1 | 10 |
| .5 | 21 | 7 | 0 | 10 |
| .1 | 22 | 15 | -1 | 10 |

Consequence: Iso 2 jetfi No 70 (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 61 | 10 | 2 | 31 |
| .5 | 63 | 23 | 0 | 31 |
| .1 | 68 | 47 | -3 | 32 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 61 | 10 | 2 | 32 |
| .5 | 63 | 23 | 0 | 31 |
| .1 | 68 | 46 | -3 | 32 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 61 | 10 | 2 | 31 |
| .5 | 63 | 23 | 0 | 31 |
| .1 | 68 | 47 | -3 | 32 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 61 | 10 | 2 | 32 |
| .5 | 63 | 23 | 0 | 31 |
| .1 | 68 | 46 | -3 | 32 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 61 | 10 | 2 | 31 |
| .5 | 63 | 23 | 0 | 31 |
| .1 | 68 | 47 | -3 | 32 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 61 | 10 | 2 | 32 |
| .5 | 63 | 23 | 0 | 31 |
| .1 | 68 | 46 | -3 | 32 |

Consequence: Iso 2 jetfi No 7m (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 5 | 0 | 2 | 4 |
| .5 | 6 | 2 | 0 | 3 |
| .1 | 7 | 5 | 0 | 3 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 5 | 0 | 3 | 4 |
| .5 | 6 | 2 | 0 | 3 |
| .1 | 7 | 4 | 0 | 3 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 5 | 0 | 2 | 4 |
| .5 | 6 | 2 | 0 | 3 |
| .1 | 7 | 5 | 0 | 3 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 5 | 0 | 3 | 4 |
| .5 | 6 | 2 | 0 | 3 |
| .1 | 7 | 4 | 0 | 3 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 5 | 0 | 2 | 4 |
| .5 | 6 | 2 | 0 | 3 |
| .1 | 7 | 5 | 0 | 3 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 5 | 0 | 3 | 4 |
| .5 | 6 | 2 | 0 | 3 |
| .1 | 7 | 4 | 0 | 3 |

Consequence: Iso 2 jetfi No ru (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| .5 | 172 | 66 | -1 | 85 |
| .1 | 187 | 131 | -9 | 89 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| .5 | 172 | 63 | -1 | 85 |
| .1 | 186 | 125 | -9 | 88 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| .5 | 172 | 66 | -1 | 85 |
| .1 | 187 | 131 | -9 | 89 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| .5 | 172 | 63 | -1 | 85 |
| .1 | 186 | 125 | -9 | 88 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| .5 | 172 | 66 | -1 | 85 |
| .1 | 187 | 131 | -9 | 89 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| .5 | 172 | 63 | -1 | 85 |
| .1 | 186 | 125 | -9 | 88 |

Consequence: Iso 2 late Man 70 (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 58 | 8 | 41 | 49 |
| .5 | 62 | 12 | 38 | 50 |
| .1 | 67 | 17 | 33 | 50 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 58 | 8 | 41 | 49 |
| .5 | 62 | 12 | 38 | 50 |
| .1 | 67 | 17 | 33 | 50 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 58 | 8 | 41 | 49 |
| .5 | 62 | 12 | 38 | 50 |
| .1 | 67 | 17 | 33 | 50 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 58 | 8 | 41 | 49 |
| .5 | 62 | 12 | 38 | 50 |
| .1 | 67 | 17 | 33 | 50 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 58 | 8 | 41 | 49 |
| .5 | 62 | 12 | 38 | 50 |
| .1 | 67 | 17 | 33 | 50 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 58 | 8 | 41 | 49 |
| .5 | 62 | 12 | 38 | 50 |
| .1 | 67 | 17 | 33 | 50 |

Consequence: Iso 2 late Man ru (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 112 | 21 | 69 | 90 |
| .5 | 122 | 32 | 57 | 89 |
| .1 | 135 | 45 | 45 | 90 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 131 | 21 | 89 | 110 |
| .5 | 141 | 31 | 79 | 110 |
| .1 | 153 | 43 | 66 | 109 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 112 | 21 | 69 | 90 |
| .5 | 122 | 32 | 57 | 89 |
| .1 | 135 | 45 | 45 | 90 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 131 | 21 | 89 | 110 |
| .5 | 141 | 31 | 79 | 110 |
| .1 | 153 | 43 | 66 | 109 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 131 | 21 | 89 | 110 |
| .5 | 141 | 31 | 79 | 110 |
| .1 | 153 | 43 | 66 | 109 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 140 | 20 | 99 | 119 |
| .5 | 149 | 29 | 90 | 119 |
| .1 | 161 | 41 | 79 | 120 |

Consequence: Iso 2 late No 70 (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 58 | 8 | 42 | 50 |
| .5 | 62 | 12 | 38 | 50 |
| .1 | 73 | 20 | 33 | 53 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 58 | 8 | 42 | 50 |
| .5 | 62 | 12 | 38 | 50 |
| .1 | 73 | 20 | 33 | 53 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|

| | | | | |
|---|---|---|---|---|
| 1 | 58 | 8 | 42 | 50 |
| .5 | 62 | 12 | 38 | 50 |
| .1 | 73 | 20 | 33 | 53 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 58 | 8 | 42 | 50 |
| .5 | 62 | 12 | 38 | 50 |
| .1 | 73 | 20 | 33 | 53 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 58 | 8 | 42 | 50 |
| .5 | 62 | 12 | 38 | 50 |
| .1 | 73 | 20 | 33 | 53 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 58 | 8 | 42 | 50 |
| .5 | 62 | 12 | 38 | 50 |
| .1 | 73 | 20 | 33 | 53 |

Consequence: Iso 2 late No ru (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 111 | 21 | 68 | 89 |
| .5 | 122 | 32 | 58 | 90 |
| .1 | 135 | 45 | 44 | 89 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 130 | 20 | 90 | 110 |
| .5 | 140 | 30 | 80 | 110 |
| .1 | 152 | 42 | 67 | 109 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 111 | 21 | 68 | 89 |
| .5 | 122 | 32 | 58 | 90 |
| .1 | 135 | 45 | 44 | 89 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 130 | 20 | 90 | 110 |
| .5 | 140 | 30 | 80 | 110 |
| .1 | 152 | 42 | 67 | 109 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 130 | 20 | 90 | 110 |
| .5 | 140 | 30 | 80 | 110 |
| .1 | 152 | 42 | 67 | 109 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 140 | 20 | 100 | 120 |
| .5 | 149 | 29 | 90 | 119 |
| .1 | 161 | 41 | 79 | 120 |

Consequence: Iso 3 jetfi Man 22 (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 19 | 3 | 1 | 10 |
| .5 | 21 | 7 | 0 | 10 |
| .1 | 22 | 15 | -1 | 10 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 19 | 3 | 1 | 10 |
| .5 | 21 | 7 | 0 | 10 |
| .1 | 22 | 15 | -1 | 10 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 19 | 3 | 1 | 10 |
| .5 | 21 | 7 | 0 | 10 |
| .1 | 22 | 15 | -1 | 10 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 19 | 3 | 1 | 10 |
| .5 | 21 | 7 | 0 | 10 |
| .1 | 22 | 15 | -1 | 10 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 19 | 3 | 1 | 10 |
| .5 | 21 | 7 | 0 | 10 |
| .1 | 22 | 15 | -1 | 10 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 19 | 3 | 1 | 10 |
| .5 | 21 | 7 | 0 | 10 |
| .1 | 22 | 15 | -1 | 10 |

Consequence: Iso 3 jetfi Man 70 (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 61 | 10 | 2 | 31 |
| .5 | 63 | 23 | 0 | 31 |
| .1 | 68 | 47 | -3 | 32 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|

| | | | | |
|---|---|---|---|---|
| 1 | 61 | 10 | 2 | 32 |
| .5 | 63 | 23 | 0 | 31 |
| .1 | 68 | 46 | -3 | 32 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 61 | 10 | 2 | 31 |
| .5 | 63 | 23 | 0 | 31 |
| .1 | 68 | 47 | -3 | 32 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 61 | 10 | 2 | 32 |
| .5 | 63 | 23 | 0 | 31 |
| .1 | 68 | 46 | -3 | 32 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 61 | 10 | 2 | 31 |
| .5 | 63 | 23 | 0 | 31 |
| .1 | 68 | 47 | -3 | 32 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 61 | 10 | 2 | 32 |
| .5 | 63 | 23 | 0 | 31 |
| .1 | 68 | 46 | -3 | 32 |

Consequence: Iso 3 jetfi Man 7m (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 5 | 0 | 2 | 4 |
| .5 | 6 | 2 | 0 | 3 |
| .1 | 7 | 5 | 0 | 3 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 5 | 0 | 3 | 4 |
| .5 | 6 | 2 | 0 | 3 |
| .1 | 7 | 4 | 0 | 3 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 5 | 0 | 2 | 4 |
| .5 | 6 | 2 | 0 | 3 |
| .1 | 7 | 5 | 0 | 3 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 5 | 0 | 3 | 4 |
| .5 | 6 | 2 | 0 | 3 |
| .1 | 7 | 4 | 0 | 3 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 5 | 0 | 2 | 4 |
| .5 | 6 | 2 | 0 | 3 |
| .1 | 7 | 5 | 0 | 3 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 5 | 0 | 3 | 4 |
| .5 | 6 | 2 | 0 | 3 |
| .1 | 7 | 4 | 0 | 3 |

Consequence: Iso 3 jetfi Man ru (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| .5 | 172 | 66 | -1 | 85 |
| .1 | 187 | 131 | -9 | 89 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| .5 | 172 | 63 | -1 | 85 |
| .1 | 186 | 125 | -9 | 88 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| .5 | 172 | 66 | -1 | 85 |
| .1 | 187 | 131 | -9 | 89 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| .5 | 172 | 63 | -1 | 85 |
| .1 | 186 | 125 | -9 | 88 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| .5 | 172 | 66 | -1 | 85 |
| .1 | 187 | 131 | -9 | 89 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| .5 | 172 | 63 | -1 | 85 |
| .1 | 186 | 125 | -9 | 88 |

Consequence: Iso 3 jetfi No 22 (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 19 | 3 | 1 | 10 |
| .5 | 21 | 7 | 0 | 10 |
| .1 | 22 | 15 | -1 | 10 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 19 | 3 | 1 | 10 |
| .5 | 21 | 7 | 0 | 10 |
| .1 | 22 | 15 | -1 | 10 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 19 | 3 | 1 | 10 |
| .5 | 21 | 7 | 0 | 10 |
| .1 | 22 | 15 | -1 | 10 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 19 | 3 | 1 | 10 |
| .5 | 21 | 7 | 0 | 10 |
| .1 | 22 | 15 | -1 | 10 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 19 | 3 | 1 | 10 |
| .5 | 21 | 7 | 0 | 10 |
| .1 | 22 | 15 | -1 | 10 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 19 | 3 | 1 | 10 |
| .5 | 21 | 7 | 0 | 10 |
| .1 | 22 | 15 | -1 | 10 |

Consequence: Iso 3 jetfi No 70 (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 61 | 10 | 2 | 31 |
| .5 | 63 | 23 | 0 | 31 |
| .1 | 68 | 47 | -3 | 32 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 61 | 10 | 2 | 32 |
| .5 | 63 | 23 | 0 | 31 |
| .1 | 68 | 46 | -3 | 32 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 61 | 10 | 2 | 31 |
| .5 | 63 | 23 | 0 | 31 |
| .1 | 68 | 47 | -3 | 32 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 61 | 10 | 2 | 32 |
| .5 | 63 | 23 | 0 | 31 |

| | | | | |
|---|---|---|---|---|
| .1 | 68 | 46 | -3 | 32 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 61 | 10 | 2 | 31 |
| .5 | 63 | 23 | 0 | 31 |
| .1 | 68 | 47 | -3 | 32 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 61 | 10 | 2 | 32 |
| .5 | 63 | 23 | 0 | 31 |
| .1 | 68 | 46 | -3 | 32 |

Consequence: Iso 3 jetfi No 7m (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 5 | 0 | 2 | 4 |
| .5 | 6 | 2 | 0 | 3 |
| .1 | 7 | 5 | 0 | 3 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 5 | 0 | 3 | 4 |
| .5 | 6 | 2 | 0 | 3 |
| .1 | 7 | 4 | 0 | 3 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 5 | 0 | 2 | 4 |
| .5 | 6 | 2 | 0 | 3 |
| .1 | 7 | 5 | 0 | 3 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 5 | 0 | 3 | 4 |
| .5 | 6 | 2 | 0 | 3 |
| .1 | 7 | 4 | 0 | 3 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 5 | 0 | 2 | 4 |
| .5 | 6 | 2 | 0 | 3 |
| .1 | 7 | 5 | 0 | 3 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 5 | 0 | 3 | 4 |
| .5 | 6 | 2 | 0 | 3 |
| .1 | 7 | 4 | 0 | 3 |

Consequence: Iso 3 jetfi No ru (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| .5 | 172 | 66 | -1 | 85 |
| .1 | 187 | 131 | -9 | 89 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| .5 | 172 | 63 | -1 | 85 |
| .1 | 186 | 125 | -9 | 88 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| .5 | 172 | 66 | -1 | 85 |
| .1 | 187 | 131 | -9 | 89 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| .5 | 172 | 63 | -1 | 85 |
| .1 | 186 | 125 | -9 | 88 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| .5 | 172 | 66 | -1 | 85 |
| .1 | 187 | 131 | -9 | 89 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| .5 | 172 | 63 | -1 | 85 |
| .1 | 186 | 125 | -9 | 88 |

Consequence: Iso 3 late Man 70 (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 58 | 8 | 41 | 49 |
| .5 | 62 | 12 | 38 | 50 |
| .1 | 67 | 17 | 33 | 50 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 58 | 8 | 41 | 49 |
| .5 | 62 | 12 | 38 | 50 |
| .1 | 67 | 17 | 33 | 50 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 58 | 8 | 41 | 49 |
| .5 | 62 | 12 | 38 | 50 |
| .1 | 67 | 17 | 33 | 50 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 58 | 8 | 41 | 49 |
| .5 | 62 | 12 | 38 | 50 |
| .1 | 67 | 17 | 33 | 50 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 58 | 8 | 41 | 49 |
| .5 | 62 | 12 | 38 | 50 |
| .1 | 67 | 17 | 33 | 50 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 58 | 8 | 41 | 49 |
| .5 | 62 | 12 | 38 | 50 |
| .1 | 67 | 17 | 33 | 50 |

Consequence: Iso 3 late Man ru (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 112 | 21 | 69 | 90 |
| .5 | 122 | 32 | 57 | 89 |
| .1 | 135 | 45 | 45 | 90 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 131 | 21 | 89 | 110 |
| .5 | 141 | 31 | 79 | 110 |
| .1 | 153 | 43 | 66 | 109 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 112 | 21 | 69 | 90 |
| .5 | 122 | 32 | 57 | 89 |
| .1 | 135 | 45 | 45 | 90 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 131 | 21 | 89 | 110 |
| .5 | 141 | 31 | 79 | 110 |
| .1 | 153 | 43 | 66 | 109 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 131 | 21 | 89 | 110 |
| .5 | 141 | 31 | 79 | 110 |
| .1 | 153 | 43 | 66 | 109 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 140 | 20 | 99 | 119 |
| .5 | 149 | 29 | 90 | 119 |
| .1 | 161 | 41 | 79 | 120 |

Consequence: Iso 3 late No 70 (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 58 | 8 | 42 | 50 |
| .5 | 62 | 12 | 38 | 50 |
| .1 | 73 | 20 | 33 | 53 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 58 | 8 | 42 | 50 |
| .5 | 62 | 12 | 38 | 50 |
| .1 | 73 | 20 | 33 | 53 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 58 | 8 | 42 | 50 |
| .5 | 62 | 12 | 38 | 50 |
| .1 | 73 | 20 | 33 | 53 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 58 | 8 | 42 | 50 |
| .5 | 62 | 12 | 38 | 50 |
| .1 | 73 | 20 | 33 | 53 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 58 | 8 | 42 | 50 |
| .5 | 62 | 12 | 38 | 50 |
| .1 | 73 | 20 | 33 | 53 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 58 | 8 | 42 | 50 |
| .5 | 62 | 12 | 38 | 50 |
| .1 | 73 | 20 | 33 | 53 |

Consequence: Iso 3 late No ru (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 111 | 21 | 68 | 89 |
| .5 | 122 | 32 | 58 | 90 |
| .1 | 135 | 45 | 44 | 89 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 130 | 20 | 90 | 110 |
| .5 | 140 | 30 | 80 | 110 |
| .1 | 152 | 42 | 67 | 109 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 111 | 21 | 68 | 89 |
| .5 | 122 | 32 | 58 | 90 |
| .1 | 135 | 45 | 44 | 89 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 130 | 20 | 90 | 110 |
| .5 | 140 | 30 | 80 | 110 |
| .1 | 152 | 42 | 67 | 109 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 130 | 20 | 90 | 110 |
| .5 | 140 | 30 | 80 | 110 |
| .1 | 152 | 42 | 67 | 109 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 140 | 20 | 100 | 120 |
| .5 | 149 | 29 | 90 | 119 |
| .1 | 161 | 41 | 79 | 120 |

Consequence: Iso 4 jetfi Man 22 (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 22 | 3 | 1 | 12 |
| .5 | 23 | 8 | 0 | 11 |
| .1 | 25 | 17 | -1 | 11 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 22 | 3 | 1 | 12 |
| .5 | 23 | 8 | 0 | 11 |
| .1 | 25 | 17 | -1 | 11 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 22 | 3 | 1 | 12 |
| .5 | 23 | 8 | 0 | 11 |
| .1 | 25 | 17 | -1 | 11 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 22 | 3 | 1 | 12 |
| .5 | 23 | 8 | 0 | 11 |
| .1 | 25 | 17 | -1 | 11 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 22 | 3 | 1 | 12 |
| .5 | 23 | 8 | 0 | 11 |
| .1 | 25 | 17 | -1 | 11 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 22 | 3 | 1 | 12 |
| .5 | 23 | 8 | 0 | 11 |
| .1 | 25 | 17 | -1 | 11 |

Consequence: Iso 4 jetfi Man 70 (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 69 | 11 | 2 | 36 |
| .5 | 71 | 27 | 0 | 35 |
| .1 | 77 | 54 | -4 | 36 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 69 | 11 | 2 | 35 |
| .5 | 71 | 26 | 0 | 35 |
| .1 | 76 | 52 | -4 | 36 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 69 | 11 | 2 | 36 |
| .5 | 71 | 27 | 0 | 35 |
| .1 | 77 | 54 | -4 | 36 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 69 | 11 | 2 | 35 |
| .5 | 71 | 26 | 0 | 35 |
| .1 | 76 | 52 | -4 | 36 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 69 | 11 | 2 | 36 |
| .5 | 71 | 27 | 0 | 35 |
| .1 | 77 | 54 | -4 | 36 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 69 | 11 | 2 | 35 |
| .5 | 71 | 26 | 0 | 35 |
| .1 | 76 | 52 | -4 | 36 |

Consequence: Iso 4 jetfi Man 7m (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 6 | 0 | 2 | 4 |
| .5 | 7 | 2 | 0 | 4 |
| .1 | 8 | 5 | 0 | 4 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 6 | 0 | 2 | 4 |
| .5 | 7 | 2 | 0 | 4 |
| .1 | 8 | 5 | 0 | 3 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 6 | 0 | 2 | 4 |
| .5 | 7 | 2 | 0 | 4 |
| .1 | 8 | 5 | 0 | 4 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 6 | 0 | 2 | 4 |
| .5 | 7 | 2 | 0 | 4 |
| .1 | 8 | 5 | 0 | 3 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 6 | 0 | 2 | 4 |
| .5 | 7 | 2 | 0 | 4 |
| .1 | 8 | 5 | 0 | 4 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 6 | 0 | 2 | 4 |
| .5 | 7 | 2 | 0 | 4 |
| .1 | 8 | 5 | 0 | 3 |

Consequence: Iso 4 jetfi Man ru (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| .5 | 194 | 74 | -1 | 96 |
| .1 | 211 | 147 | -12 | 99 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| .5 | 194 | 71 | -1 | 96 |
| .1 | 210 | 141 | -11 | 99 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| .5 | 194 | 74 | -1 | 96 |
| .1 | 211 | 147 | -12 | 99 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| .5 | 194 | 71 | -1 | 96 |
| .1 | 210 | 141 | -11 | 99 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| .5 | 194 | 74 | -1 | 96 |
| .1 | 211 | 147 | -12 | 99 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| .5 | 194 | 71 | -1 | 96 |
| .1 | 210 | 141 | -11 | 99 |

Consequence: Iso 4 jetfi No 22 (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 22 | 3 | 1 | 12 |
| .5 | 23 | 8 | 0 | 11 |
| .1 | 25 | 17 | -1 | 11 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 22 | 3 | 1 | 12 |
| .5 | 23 | 8 | 0 | 11 |
| .1 | 25 | 17 | -1 | 11 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 22 | 3 | 1 | 12 |
| .5 | 23 | 8 | 0 | 11 |
| .1 | 25 | 17 | -1 | 11 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 22 | 3 | 1 | 12 |
| .5 | 23 | 8 | 0 | 11 |
| .1 | 25 | 17 | -1 | 11 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 22 | 3 | 1 | 12 |
| .5 | 23 | 8 | 0 | 11 |
| .1 | 25 | 17 | -1 | 11 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 22 | 3 | 1 | 12 |
| .5 | 23 | 8 | 0 | 11 |
| .1 | 25 | 17 | -1 | 11 |

Consequence: Iso 4 jetfi No 70 (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 69 | 11 | 2 | 36 |
| .5 | 71 | 27 | 0 | 35 |
| .1 | 77 | 54 | -4 | 36 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 69 | 11 | 2 | 35 |
| .5 | 71 | 26 | 0 | 35 |
| .1 | 76 | 52 | -4 | 36 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 69 | 11 | 2 | 36 |
| .5 | 71 | 27 | 0 | 35 |
| .1 | 77 | 54 | -4 | 36 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 69 | 11 | 2 | 35 |
| .5 | 71 | 26 | 0 | 35 |
| .1 | 76 | 52 | -4 | 36 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 69 | 11 | 2 | 36 |
| .5 | 71 | 27 | 0 | 35 |
| .1 | 77 | 54 | -4 | 36 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 69 | 11 | 2 | 35 |
| .5 | 71 | 26 | 0 | 35 |
| .1 | 76 | 52 | -4 | 36 |

Consequence: Iso 4 jetfi No 7m (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 6 | 0 | 2 | 4 |
| .5 | 7 | 2 | 0 | 4 |
| .1 | 8 | 5 | 0 | 4 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 6 | 0 | 2 | 4 |
| .5 | 7 | 2 | 0 | 4 |
| .1 | 8 | 5 | 0 | 3 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 6 | 0 | 2 | 4 |
| .5 | 7 | 2 | 0 | 4 |
| .1 | 8 | 5 | 0 | 4 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|

| | | | | |
|---|---|---|---|---|
| 1 | 6 | 0 | 2 | 4 |
| .5 | 7 | 2 | 0 | 4 |
| .1 | 8 | 5 | 0 | 3 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 6 | 0 | 2 | 4 |
| .5 | 7 | 2 | 0 | 4 |
| .1 | 8 | 5 | 0 | 4 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 6 | 0 | 2 | 4 |
| .5 | 7 | 2 | 0 | 4 |
| .1 | 8 | 5 | 0 | 3 |

Consequence: Iso 4 jetfi No ru (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| .5 | 194 | 74 | -1 | 96 |
| .1 | 211 | 147 | -12 | 99 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| .5 | 194 | 71 | -1 | 96 |
| .1 | 210 | 141 | -11 | 99 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| .5 | 194 | 74 | -1 | 96 |
| .1 | 211 | 147 | -12 | 99 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| .5 | 194 | 71 | -1 | 96 |
| .1 | 210 | 141 | -11 | 99 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| .5 | 194 | 74 | -1 | 96 |
| .1 | 211 | 147 | -12 | 99 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| .5 | 194 | 71 | -1 | 96 |
| .1 | 210 | 141 | -11 | 99 |

Consequence: Iso 4 late Man 22 (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|

| | | | | |
|---|---|---|---|---|
| 1 | 23 | 3 | 16 | 19 |
| .5 | 25 | 5 | 15 | 20 |
| .1 | 27 | 7 | 13 | 20 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 23 | 3 | 16 | 19 |
| .5 | 25 | 5 | 15 | 20 |
| .1 | 27 | 7 | 13 | 20 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 23 | 3 | 16 | 19 |
| .5 | 25 | 5 | 15 | 20 |
| .1 | 27 | 7 | 13 | 20 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 23 | 3 | 16 | 19 |
| .5 | 25 | 5 | 15 | 20 |
| .1 | 27 | 7 | 13 | 20 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 12 | 2 | 7 | 10 |
| .5 | 13 | 3 | 6 | 9 |
| .1 | 15 | 5 | 4 | 10 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 12 | 2 | 7 | 10 |
| .5 | 13 | 3 | 6 | 9 |
| .1 | 15 | 5 | 4 | 10 |

Consequence: Iso 4 late Man 70 (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 61 | 11 | 38 | 49 |
| .5 | 67 | 17 | 33 | 50 |
| .1 | 74 | 24 | 26 | 50 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 71 | 11 | 49 | 60 |
| .5 | 76 | 16 | 44 | 60 |
| .1 | 83 | 23 | 37 | 60 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 61 | 11 | 38 | 49 |
| .5 | 67 | 17 | 33 | 50 |
| .1 | 74 | 24 | 26 | 50 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 71 | 11 | 49 | 60 |
| .5 | 76 | 16 | 44 | 60 |
| .1 | 83 | 23 | 37 | 60 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 71 | 11 | 49 | 60 |
| .5 | 76 | 16 | 44 | 60 |
| .1 | 83 | 23 | 37 | 60 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 71 | 11 | 49 | 60 |
| .5 | 76 | 16 | 44 | 60 |
| .1 | 83 | 23 | 37 | 60 |

Consequence: Iso 4 late Man ru (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 118 | 28 | 62 | 90 |
| .5 | 131 | 41 | 49 | 90 |
| .1 | 148 | 58 | 31 | 89 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 138 | 28 | 82 | 110 |
| .5 | 151 | 41 | 68 | 109 |
| .1 | 168 | 58 | 51 | 109 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 118 | 28 | 62 | 90 |
| .5 | 131 | 41 | 49 | 90 |
| .1 | 148 | 58 | 31 | 89 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 147 | 27 | 92 | 119 |
| .5 | 168 | 45 | 78 | 123 |
| .1 | 178 | 58 | 61 | 119 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 147 | 27 | 92 | 119 |
| .5 | 168 | 45 | 78 | 123 |
| .1 | 178 | 58 | 61 | 119 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 158 | 28 | 102 | 130 |
| .5 | 171 | 41 | 88 | 129 |

| | | | | |
|---|---|---|---|---|
| .1 | 187 | 57 | 73 | 130 |

Consequence: Iso 4 late No 22 (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 23 | 3 | 17 | 20 |
| .5 | 25 | 5 | 15 | 20 |
| .1 | 27 | 7 | 13 | 20 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 23 | 3 | 17 | 20 |
| .5 | 25 | 5 | 15 | 20 |
| .1 | 27 | 7 | 13 | 20 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 23 | 3 | 17 | 20 |
| .5 | 25 | 5 | 15 | 20 |
| .1 | 27 | 7 | 13 | 20 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 23 | 3 | 17 | 20 |
| .5 | 25 | 5 | 15 | 20 |
| .1 | 27 | 7 | 13 | 20 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 12 | 2 | 8 | 10 |
| .5 | 14 | 4 | 6 | 10 |
| .1 | 15 | 5 | 4 | 9 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 12 | 2 | 8 | 10 |
| .5 | 14 | 4 | 6 | 10 |
| .1 | 15 | 5 | 4 | 9 |

Consequence: Iso 4 late No 70 (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 61 | 11 | 38 | 50 |
| .5 | 67 | 17 | 32 | 50 |
| .1 | 74 | 24 | 25 | 50 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 71 | 11 | 49 | 60 |
| .5 | 76 | 16 | 44 | 60 |
| .1 | 82 | 22 | 38 | 60 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 61 | 11 | 38 | 50 |
| .5 | 67 | 17 | 32 | 50 |
| .1 | 74 | 24 | 25 | 50 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 71 | 11 | 49 | 60 |
| .5 | 76 | 16 | 44 | 60 |
| .1 | 82 | 22 | 38 | 60 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 71 | 11 | 49 | 60 |
| .5 | 76 | 16 | 44 | 60 |
| .1 | 82 | 22 | 38 | 60 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 71 | 11 | 49 | 60 |
| .5 | 76 | 16 | 44 | 60 |
| .1 | 82 | 22 | 38 | 60 |

Consequence: Iso 4 late No ru (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 118 | 28 | 62 | 90 |
| .5 | 130 | 40 | 49 | 89 |
| .1 | 148 | 58 | 32 | 90 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 137 | 27 | 82 | 109 |
| .5 | 151 | 41 | 68 | 109 |
| .1 | 167 | 58 | 51 | 109 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 118 | 28 | 62 | 90 |
| .5 | 130 | 40 | 49 | 89 |
| .1 | 148 | 58 | 32 | 90 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 147 | 27 | 92 | 119 |
| .5 | 162 | 42 | 78 | 120 |
| .1 | 178 | 58 | 61 | 119 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 147 | 27 | 92 | 119 |
| .5 | 162 | 42 | 78 | 120 |

| | | | | |
|---|---|---|---|---|
| .1 | 178 | 58 | 61 | 119 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 158 | 28 | 102 | 130 |
| .5 | 171 | 41 | 89 | 130 |
| .1 | 187 | 57 | 73 | 130 |

Consequence: Iso 5 jetfi Man 22 (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 46 | 8 | 2 | 24 |
| .5 | 47 | 18 | 0 | 23 |
| .1 | 51 | 36 | -3 | 24 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 46 | 7 | 2 | 24 |
| .5 | 47 | 17 | 0 | 23 |
| .1 | 51 | 35 | -3 | 24 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 46 | 8 | 2 | 24 |
| .5 | 47 | 18 | 0 | 23 |
| .1 | 51 | 36 | -3 | 24 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 46 | 7 | 2 | 24 |
| .5 | 47 | 17 | 0 | 23 |
| .1 | 51 | 35 | -3 | 24 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 46 | 8 | 2 | 24 |
| .5 | 47 | 18 | 0 | 23 |
| .1 | 51 | 36 | -3 | 24 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 46 | 7 | 2 | 24 |
| .5 | 47 | 17 | 0 | 23 |
| .1 | 51 | 35 | -3 | 24 |

Consequence: Iso 5 jetfi Man 70 (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 141 | 8 | 3 | 72 |
| .5 | 144 | 56 | -1 | 71 |
| .1 | 157 | 111 | -9 | 73 |

Weather state: 2.5B

Fatality

| prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 140 | 8 | 3 | 72 |
| .5 | 144 | 53 | -1 | 71 |
| .1 | 155 | 106 | -9 | 73 |

Weather state: 3.0F

Fatality

| prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 141 | 8 | 3 | 72 |
| .5 | 144 | 56 | -1 | 71 |
| .1 | 157 | 111 | -9 | 73 |

Weather state: 4.2C

Fatality

| prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 140 | 8 | 3 | 72 |
| .5 | 144 | 53 | -1 | 71 |
| .1 | 155 | 106 | -9 | 73 |

Weather state: 5.1D

Fatality

| prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 141 | 8 | 3 | 72 |
| .5 | 144 | 56 | -1 | 71 |
| .1 | 157 | 111 | -9 | 73 |

Weather state: 6.3C

Fatality

| prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 140 | 8 | 3 | 72 |
| .5 | 144 | 53 | -1 | 71 |
| .1 | 155 | 106 | -9 | 73 |

Consequence: Iso 5 jetfi Man 7m (unaffected by topography)

Weather state: 1.8F

Fatality

| prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 14 | 2 | 1 | 8 |
| .5 | 16 | 5 | 0 | 8 |
| .1 | 17 | 12 | -1 | 8 |

Weather state: 2.5B

Fatality

| prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 14 | 2 | 1 | 8 |
| .5 | 16 | 5 | 0 | 8 |
| .1 | 17 | 11 | -1 | 8 |

Weather state: 3.0F

Fatality

| prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 14 | 2 | 1 | 8 |
| .5 | 16 | 5 | 0 | 8 |
| .1 | 17 | 12 | -1 | 8 |

Weather state: 4.2C

Fatality

| prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 14 | 2 | 1 | 8 |
| .5 | 16 | 5 | 0 | 8 |

| | | | | |
|---|---|---|---|---|
| .1 | 17 | 11 | -1 | 8 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 14 | 2 | 1 | 8 |
| .5 | 16 | 5 | 0 | 8 |
| .1 | 17 | 12 | -1 | 8 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 14 | 2 | 1 | 8 |
| .5 | 16 | 5 | 0 | 8 |
| .1 | 17 | 11 | -1 | 8 |

Consequence: Iso 5 jetfi Man ru (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| .5 | 392 | 153 | -5 | 193 |
| .1 | 428 | 299 | -24 | 201 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| .5 | 393 | 144 | -3 | 194 |
| .1 | 427 | 285 | -22 | 202 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| .5 | 392 | 153 | -5 | 193 |
| .1 | 428 | 299 | -24 | 201 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| .5 | 393 | 144 | -3 | 194 |
| .1 | 427 | 285 | -22 | 202 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| .5 | 392 | 153 | -5 | 193 |
| .1 | 428 | 299 | -24 | 201 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| .5 | 393 | 144 | -3 | 194 |
| .1 | 427 | 285 | -22 | 202 |

Consequence: Iso 5 jetfi No 22 (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 46 | 8 | 2 | 24 |
| .5 | 47 | 18 | 0 | 23 |

| | | | | |
|---|---|---|---|---|
| .1 | 51 | 36 | -3 | 24 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 46 | 7 | 2 | 24 |
| .5 | 47 | 17 | 0 | 23 |
| .1 | 51 | 35 | -3 | 24 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 46 | 8 | 2 | 24 |
| .5 | 47 | 18 | 0 | 23 |
| .1 | 51 | 36 | -3 | 24 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 46 | 7 | 2 | 24 |
| .5 | 47 | 17 | 0 | 23 |
| .1 | 51 | 35 | -3 | 24 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 46 | 8 | 2 | 24 |
| .5 | 47 | 18 | 0 | 23 |
| .1 | 51 | 36 | -3 | 24 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 46 | 7 | 2 | 24 |
| .5 | 47 | 17 | 0 | 23 |
| .1 | 51 | 35 | -3 | 24 |

Consequence: Iso 5 jetfi No 70 (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 141 | 8 | 3 | 72 |
| .5 | 144 | 56 | -1 | 71 |
| .1 | 157 | 111 | -9 | 73 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 140 | 8 | 3 | 72 |
| .5 | 144 | 53 | -1 | 71 |
| .1 | 155 | 106 | -9 | 73 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 141 | 8 | 3 | 72 |
| .5 | 144 | 56 | -1 | 71 |
| .1 | 157 | 111 | -9 | 73 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 140 | 8 | 3 | 72 |
| .5 | 144 | 53 | -1 | 71 |
| .1 | 155 | 106 | -9 | 73 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 141 | 8 | 3 | 72 |
| .5 | 144 | 56 | -1 | 71 |
| .1 | 157 | 111 | -9 | 73 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 140 | 8 | 3 | 72 |
| .5 | 144 | 53 | -1 | 71 |
| .1 | 155 | 106 | -9 | 73 |

Consequence: Iso 5 jetfi No 7m (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 14 | 2 | 1 | 8 |
| .5 | 16 | 5 | 0 | 8 |
| .1 | 17 | 12 | -1 | 8 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 14 | 2 | 1 | 8 |
| .5 | 16 | 5 | 0 | 8 |
| .1 | 17 | 11 | -1 | 8 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 14 | 2 | 1 | 8 |
| .5 | 16 | 5 | 0 | 8 |
| .1 | 17 | 12 | -1 | 8 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 14 | 2 | 1 | 8 |
| .5 | 16 | 5 | 0 | 8 |
| .1 | 17 | 11 | -1 | 8 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 14 | 2 | 1 | 8 |
| .5 | 16 | 5 | 0 | 8 |
| .1 | 17 | 12 | -1 | 8 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 14 | 2 | 1 | 8 |
| .5 | 16 | 5 | 0 | 8 |
| .1 | 17 | 11 | -1 | 8 |

Consequence: Iso 5 jetfi No ru (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| .5 | 392 | 153 | -5 | 193 |
| .1 | 428 | 299 | -24 | 201 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| .5 | 393 | 144 | -3 | 194 |
| .1 | 427 | 285 | -22 | 202 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| .5 | 392 | 153 | -5 | 193 |
| .1 | 428 | 299 | -24 | 201 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| .5 | 393 | 144 | -3 | 194 |
| .1 | 427 | 285 | -22 | 202 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| .5 | 392 | 153 | -5 | 193 |
| .1 | 428 | 299 | -24 | 201 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| .5 | 393 | 144 | -3 | 194 |
| .1 | 427 | 285 | -22 | 202 |

Consequence: Iso 5 late Man 22 (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 55 | 5 | 45 | 50 |
| .5 | 57 | 7 | 42 | 49 |
| .1 | 60 | 10 | 40 | 50 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 55 | 5 | 45 | 50 |
| .5 | 57 | 7 | 42 | 49 |
| .1 | 60 | 10 | 40 | 50 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 55 | 5 | 45 | 50 |
| .5 | 57 | 7 | 42 | 49 |
| .1 | 60 | 10 | 40 | 50 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 55 | 5 | 45 | 50 |
| .5 | 57 | 7 | 42 | 49 |
| .1 | 60 | 10 | 40 | 50 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 44 | 4 | 35 | 39 |
| .5 | 46 | 6 | 33 | 39 |
| .1 | 49 | 9 | 31 | 40 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 44 | 4 | 35 | 39 |
| .5 | 46 | 6 | 33 | 39 |
| .1 | 49 | 9 | 31 | 40 |

Consequence: Iso 5 late Man 70 (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 248 | 19 | 210 | 229 |
| .5 | 258 | 28 | 201 | 229 |
| .1 | 269 | 39 | 191 | 230 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| .5 | 255 | 25 | 205 | 230 |
| 1 | 267 | 26 | 214 | 240 |
| .1 | 265 | 35 | 195 | 230 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 259 | 18 | 222 | 240 |
| .5 | 269 | 29 | 211 | 240 |
| .1 | 279 | 39 | 201 | 240 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 256 | 17 | 222 | 239 |
| .5 | 265 | 25 | 215 | 240 |
| .1 | 275 | 35 | 204 | 239 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 256 | 17 | 222 | 239 |
| .5 | 265 | 25 | 215 | 240 |
| .1 | 275 | 35 | 204 | 239 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|

| | | | | |
|---|---|---|---|---|
| 1 | 267 | 17 | 233 | 250 |
| .5 | 275 | 25 | 225 | 250 |
| .1 | 285 | 35 | 215 | 250 |

Consequence: Iso 5 late Man ru (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 535 | 57 | 421 | 478 |
| .5 | 565 | 85 | 395 | 480 |
| .1 | 599 | 119 | 361 | 480 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 541 | 50 | 440 | 490 |
| .5 | 567 | 77 | 413 | 490 |
| .1 | 597 | 107 | 382 | 489 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 556 | 52 | 452 | 504 |
| .5 | 591 | 83 | 425 | 508 |
| .1 | 628 | 118 | 392 | 510 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 601 | 50 | 500 | 550 |
| .5 | 626 | 76 | 473 | 549 |
| .1 | 654 | 105 | 443 | 548 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 631 | 51 | 528 | 579 |
| .5 | 656 | 77 | 502 | 579 |
| .1 | 687 | 106 | 474 | 580 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 651 | 50 | 551 | 601 |
| .5 | 676 | 76 | 524 | 600 |
| .1 | 705 | 104 | 496 | 600 |

Consequence: Iso 5 late No 22 (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 55 | 5 | 45 | 50 |
| .5 | 57 | 7 | 42 | 49 |
| .1 | 60 | 10 | 40 | 50 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 55 | 5 | 45 | 50 |
| .5 | 56 | 6 | 43 | 49 |
| .1 | 59 | 9 | 41 | 50 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 55 | 5 | 45 | 50 |
| .5 | 57 | 7 | 42 | 49 |
| .1 | 60 | 10 | 40 | 50 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 55 | 5 | 45 | 50 |
| .5 | 56 | 6 | 43 | 49 |
| .1 | 59 | 9 | 41 | 50 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 44 | 4 | 36 | 40 |
| .5 | 46 | 6 | 33 | 39 |
| .1 | 48 | 8 | 31 | 39 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 44 | 4 | 36 | 40 |
| .5 | 46 | 6 | 33 | 39 |
| .1 | 48 | 8 | 31 | 39 |

Consequence: Iso 5 late No 70 (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 249 | 19 | 210 | 229 |
| .5 | 258 | 28 | 201 | 229 |
| .1 | 269 | 39 | 190 | 229 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 247 | 16 | 214 | 230 |
| .5 | 254 | 24 | 205 | 229 |
| .1 | 265 | 35 | 195 | 230 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 259 | 19 | 221 | 240 |
| .5 | 268 | 28 | 211 | 239 |
| .1 | 278 | 38 | 202 | 240 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 256 | 16 | 223 | 239 |
| .5 | 265 | 25 | 215 | 240 |
| .1 | 274 | 34 | 205 | 239 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|

| | | | | |
|---|---|---|---|---|
| 1 | 256 | 16 | 223 | 239 |
| .5 | 265 | 25 | 215 | 240 |
| .1 | 274 | 34 | 205 | 239 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 268 | 17 | 233 | 250 |
| .5 | 276 | 25 | 225 | 250 |
| .1 | 285 | 35 | 215 | 250 |

Consequence: Iso 5 late No ru (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 497 | 57 | 382 | 439 |
| .5 | 524 | 85 | 353 | 438 |
| .1 | 555 | 115 | 325 | 440 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 502 | 51 | 400 | 451 |
| .5 | 528 | 78 | 372 | 450 |
| .1 | 555 | 106 | 342 | 448 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 518 | 56 | 405 | 461 |
| .5 | 545 | 85 | 375 | 460 |
| .1 | 575 | 115 | 345 | 460 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 559 | 49 | 460 | 509 |
| .5 | 583 | 73 | 436 | 509 |
| .1 | 610 | 100 | 409 | 509 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 571 | 50 | 471 | 521 |
| .5 | 584 | 75 | 433 | 508 |
| .1 | 625 | 106 | 413 | 519 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 591 | 51 | 488 | 539 |
| .5 | 615 | 75 | 464 | 539 |
| .1 | 642 | 103 | 435 | 538 |

Consequence: Iso 6 late Man 22 (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 13 | 3 | 6 | 10 |
| .5 | 15 | 5 | 5 | 10 |
| .1 | 17 | 7 | 3 | 10 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 24 | 4 | 16 | 20 |
| .5 | 25 | 5 | 15 | 20 |
| .1 | 27 | 7 | 13 | 20 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 13 | 3 | 6 | 10 |
| .5 | 15 | 5 | 5 | 10 |
| .1 | 17 | 7 | 3 | 10 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 24 | 4 | 16 | 20 |
| .5 | 25 | 5 | 15 | 20 |
| .1 | 27 | 7 | 13 | 20 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 13 | 3 | 6 | 10 |
| .5 | 15 | 5 | 5 | 10 |
| .1 | 17 | 7 | 3 | 10 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 13 | 3 | 6 | 10 |
| .5 | 15 | 5 | 5 | 10 |
| .1 | 17 | 7 | 3 | 10 |

Consequence: Iso 6 late Man 70 (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 56 | 6 | 44 | 50 |
| .5 | 58 | 8 | 42 | 50 |
| .1 | 62 | 12 | 38 | 50 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 77 | 7 | 63 | 70 |
| .5 | 80 | 10 | 60 | 70 |
| .1 | 83 | 13 | 57 | 70 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 66 | 6 | 54 | 60 |
| .5 | 68 | 8 | 52 | 60 |
| .1 | 72 | 12 | 48 | 60 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|

| | | | | |
|---|---|---|---|---|
| 1 | 77 | 7 | 63 | 70 |
| .5 | 80 | 10 | 60 | 70 |
| .1 | 83 | 13 | 57 | 70 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 57 | 7 | 43 | 50 |
| .5 | 60 | 10 | 40 | 50 |
| .1 | 64 | 14 | 36 | 50 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 67 | 7 | 53 | 60 |
| .5 | 70 | 10 | 50 | 60 |
| .1 | 74 | 14 | 46 | 60 |

Consequence: Iso 6 late Man ru (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 120 | 10 | 100 | 110 |
| .5 | 125 | 15 | 95 | 110 |
| .1 | 132 | 22 | 88 | 110 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 120 | 10 | 100 | 110 |
| .5 | 125 | 15 | 95 | 110 |
| .1 | 132 | 22 | 88 | 110 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 120 | 10 | 100 | 110 |
| .5 | 125 | 15 | 95 | 110 |
| .1 | 132 | 22 | 88 | 110 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 131 | 11 | 109 | 120 |
| .5 | 137 | 17 | 103 | 120 |
| .1 | 143 | 23 | 97 | 120 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 120 | 10 | 100 | 110 |
| .5 | 125 | 15 | 95 | 110 |
| .1 | 132 | 22 | 88 | 110 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 131 | 11 | 109 | 120 |
| .5 | 137 | 17 | 103 | 120 |
| .1 | 143 | 23 | 97 | 120 |

Consequence: Iso 6 late No 22 (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 13 | 3 | 6 | 10 |
| .5 | 15 | 5 | 5 | 10 |
| .1 | 17 | 7 | 3 | 10 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 24 | 4 | 16 | 20 |
| .5 | 25 | 5 | 15 | 20 |
| .1 | 27 | 7 | 13 | 20 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 13 | 3 | 6 | 10 |
| .5 | 15 | 5 | 5 | 10 |
| .1 | 17 | 7 | 3 | 10 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 24 | 4 | 16 | 20 |
| .5 | 25 | 5 | 15 | 20 |
| .1 | 27 | 7 | 13 | 20 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 13 | 3 | 6 | 10 |
| .5 | 15 | 5 | 5 | 10 |
| .1 | 17 | 7 | 3 | 10 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 13 | 3 | 6 | 10 |
| .5 | 15 | 5 | 5 | 10 |
| .1 | 17 | 7 | 3 | 10 |

Consequence: Iso 6 late No 70 (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 56 | 6 | 44 | 50 |
| .5 | 58 | 8 | 42 | 50 |
| .1 | 62 | 12 | 38 | 50 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 77 | 7 | 63 | 70 |
| .5 | 80 | 10 | 60 | 70 |
| .1 | 83 | 13 | 57 | 70 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|

| | | | | |
|---|---|---|---|---|
| 1 | 66 | 6 | 54 | 60 |
| .5 | 68 | 8 | 52 | 60 |
| .1 | 72 | 12 | 48 | 60 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 77 | 7 | 63 | 70 |
| .5 | 80 | 10 | 60 | 70 |
| .1 | 83 | 13 | 57 | 70 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 57 | 7 | 43 | 50 |
| .5 | 60 | 10 | 40 | 50 |
| .1 | 64 | 14 | 36 | 50 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 67 | 7 | 53 | 60 |
| .5 | 70 | 10 | 50 | 60 |
| .1 | 74 | 14 | 46 | 60 |

Consequence: Iso 6 late No ru (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 120 | 10 | 100 | 110 |
| .5 | 125 | 15 | 95 | 110 |
| .1 | 132 | 22 | 88 | 110 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 120 | 10 | 100 | 110 |
| .5 | 125 | 15 | 95 | 110 |
| .1 | 132 | 22 | 88 | 110 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 120 | 10 | 100 | 110 |
| .5 | 125 | 15 | 95 | 110 |
| .1 | 132 | 22 | 88 | 110 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 131 | 11 | 109 | 120 |
| .5 | 137 | 17 | 103 | 120 |
| .1 | 143 | 23 | 97 | 120 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 120 | 10 | 100 | 110 |
| .5 | 125 | 15 | 95 | 110 |
| .1 | 132 | 22 | 88 | 110 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 131 | 11 | 109 | 120 |
| .5 | 137 | 17 | 103 | 120 |
| .1 | 143 | 23 | 97 | 120 |

Consequence: Iso 6 poolf Man 22 (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 45 | 29 | -13 | 15 |
| .5 | 63 | 47 | -31 | 16 |
| .1 | 93 | 77 | -62 | 15 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 45 | 28 | -12 | 16 |
| .5 | 63 | 46 | -29 | 17 |
| .1 | 93 | 75 | -58 | 17 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 46 | 28 | -12 | 16 |
| .5 | 63 | 45 | -28 | 17 |
| .1 | 92 | 74 | -57 | 17 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 48 | 27 | -10 | 19 |
| .5 | 65 | 44 | -25 | 19 |
| .1 | 92 | 71 | -52 | 20 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 49 | 27 | -10 | 19 |
| .5 | 64 | 43 | -24 | 20 |
| .1 | 90 | 70 | -51 | 19 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 50 | 26 | -9 | 20 |
| .5 | 65 | 42 | -22 | 21 |
| .1 | 90 | 68 | -47 | 21 |

Consequence: Iso 6 poolf Man 70 (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 97 | 70 | -43 | 26 |
| .5 | 138 | 110 | -82 | 27 |
| .1 | 204 | 176 | -151 | 26 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|

| | | | | |
|---|---|---|---|---|
| 1 | 98 | 67 | -39 | 29 |
| .5 | 135 | 105 | -76 | 29 |
| .1 | 198 | 169 | -140 | 28 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 101 | 69 | -40 | 30 |
| .5 | 138 | 107 | -77 | 30 |
| .1 | 201 | 172 | -143 | 29 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 102 | 65 | -34 | 33 |
| .5 | 137 | 101 | -67 | 34 |
| .1 | 196 | 160 | -128 | 34 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 104 | 66 | -35 | 34 |
| .5 | 138 | 102 | -68 | 35 |
| .1 | 197 | 162 | -129 | 34 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 103 | 64 | -33 | 34 |
| .5 | 136 | 97 | -62 | 36 |
| .1 | 191 | 154 | -117 | 37 |

Consequence: Iso 6 poolf Man 7m (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 23 | 14 | -5 | 9 |
| .5 | 33 | 23 | -14 | 9 |
| .1 | 49 | 39 | -29 | 9 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 23 | 11 | -2 | 10 |
| .5 | 31 | 19 | -9 | 11 |
| .1 | 44 | 32 | -21 | 11 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 24 | 13 | -4 | 10 |
| .5 | 33 | 22 | -11 | 10 |
| .1 | 47 | 36 | -26 | 10 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 23 | 10 | 0 | 11 |
| .5 | 30 | 18 | -6 | 12 |
| .1 | 42 | 29 | -17 | 12 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 26 | 11 | 0 | 12 |
| .5 | 33 | 19 | -7 | 13 |
| .1 | 45 | 32 | -19 | 13 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 25 | 9 | 2 | 14 |
| .5 | 31 | 16 | -2 | 14 |
| .1 | 41 | 26 | -12 | 14 |

Consequence: Iso 6 poolf Man ru (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 110 | 72 | -36 | 36 |
| .5 | 151 | 113 | -76 | 37 |
| .1 | 219 | 183 | -146 | 36 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 111 | 71 | -33 | 39 |
| .5 | 152 | 111 | -71 | 40 |
| .1 | 217 | 178 | -139 | 39 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 112 | 71 | -33 | 39 |
| .5 | 151 | 111 | -71 | 40 |
| .1 | 217 | 178 | -139 | 39 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 118 | 69 | -26 | 46 |
| .5 | 156 | 107 | -60 | 47 |
| .1 | 217 | 169 | -125 | 46 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 115 | 69 | -30 | 42 |
| .5 | 152 | 106 | -63 | 44 |
| .1 | 212 | 169 | -127 | 42 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 120 | 68 | -25 | 47 |
| .5 | 155 | 103 | -55 | 49 |
| .1 | 213 | 162 | -115 | 49 |

Consequence: Iso 6 poolf No 22 (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|

| | | | | |
|---|---|---|---|---|
| 1 | 45 | 29 | -13 | 15 |
| .5 | 63 | 47 | -31 | 16 |
| .1 | 93 | 77 | -62 | 15 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 45 | 28 | -12 | 16 |
| .5 | 63 | 46 | -29 | 17 |
| .1 | 93 | 75 | -58 | 17 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 46 | 28 | -12 | 16 |
| .5 | 63 | 45 | -28 | 17 |
| .1 | 92 | 74 | -57 | 17 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 48 | 27 | -10 | 19 |
| .5 | 65 | 44 | -25 | 19 |
| .1 | 92 | 71 | -52 | 20 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 49 | 27 | -10 | 19 |
| .5 | 64 | 43 | -24 | 20 |
| .1 | 90 | 70 | -51 | 19 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 45 | 28 | -12 | 16 |
| .5 | 63 | 46 | -29 | 17 |
| .1 | 93 | 75 | -58 | 17 |

Consequence: Iso 6 poolf No 70 (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 96 | 69 | -42 | 27 |
| .5 | 135 | 108 | -81 | 27 |
| .1 | 201 | 174 | -148 | 26 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 96 | 66 | -38 | 29 |
| .5 | 134 | 103 | -74 | 30 |
| .1 | 195 | 166 | -138 | 28 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 99 | 67 | -39 | 29 |
| .5 | 137 | 105 | -75 | 30 |
| .1 | 200 | 169 | -139 | 30 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 100 | 64 | -34 | 33 |
| .5 | 136 | 99 | -65 | 35 |
| .1 | 195 | 158 | -124 | 35 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 103 | 65 | -34 | 34 |
| .5 | 137 | 100 | -66 | 35 |
| .1 | 196 | 159 | -125 | 35 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 96 | 66 | -38 | 29 |
| .5 | 134 | 103 | -74 | 30 |
| .1 | 195 | 166 | -138 | 28 |

Consequence: Iso 6 poolf No 7m (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 23 | 14 | -5 | 9 |
| .5 | 33 | 23 | -14 | 9 |
| .1 | 49 | 39 | -29 | 9 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 23 | 11 | -2 | 10 |
| .5 | 31 | 19 | -9 | 11 |
| .1 | 44 | 32 | -21 | 11 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 24 | 13 | -4 | 10 |
| .5 | 33 | 22 | -11 | 10 |
| .1 | 47 | 36 | -26 | 10 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 23 | 10 | 0 | 11 |
| .5 | 30 | 18 | -6 | 12 |
| .1 | 42 | 29 | -17 | 12 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 26 | 11 | 0 | 12 |
| .5 | 33 | 19 | -7 | 13 |
| .1 | 45 | 32 | -19 | 13 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 23 | 11 | -2 | 10 |
| .5 | 31 | 19 | -9 | 11 |

| | | | | |
|---|---|---|---|---|
| .1 | 44 | 32 | -21 | 11 |

Consequence: Iso 6 poolf No ru (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 108 | 71 | -35 | 36 |
| .5 | 149 | 112 | -75 | 36 |
| .1 | 216 | 178 | -144 | 36 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 110 | 69 | -32 | 39 |
| .5 | 149 | 109 | -70 | 39 |
| .1 | 213 | 175 | -136 | 38 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 111 | 70 | -32 | 39 |
| .5 | 149 | 109 | -70 | 39 |
| .1 | 213 | 175 | -136 | 38 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 116 | 68 | -25 | 45 |
| .5 | 153 | 105 | -59 | 46 |
| .1 | 215 | 167 | -121 | 47 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 114 | 68 | -29 | 42 |
| .5 | 149 | 104 | -62 | 43 |
| .1 | 210 | 166 | -123 | 43 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 110 | 69 | -32 | 39 |
| .5 | 149 | 109 | -70 | 39 |
| .1 | 213 | 175 | -136 | 38 |

Consequence: Iso 7 late Man 22 (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 22 | 2 | 17 | 20 |
| .5 | 24 | 4 | 16 | 20 |
| .1 | 25 | 5 | 14 | 20 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 22 | 2 | 17 | 20 |
| .5 | 24 | 4 | 16 | 20 |
| .1 | 25 | 5 | 14 | 20 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 22 | 2 | 17 | 20 |
| .5 | 24 | 4 | 16 | 20 |
| .1 | 25 | 5 | 14 | 20 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 22 | 2 | 17 | 20 |
| .5 | 24 | 4 | 16 | 20 |
| .1 | 25 | 5 | 14 | 20 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 22 | 2 | 17 | 20 |
| .5 | 24 | 4 | 16 | 20 |
| .1 | 25 | 5 | 14 | 20 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 22 | 2 | 17 | 20 |
| .5 | 24 | 4 | 16 | 20 |
| .1 | 25 | 5 | 14 | 20 |

Consequence: Iso 7 late Man 70 (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 33 | 3 | 26 | 30 |
| .5 | 35 | 5 | 25 | 30 |
| .1 | 37 | 7 | 23 | 30 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 44 | 4 | 36 | 40 |
| .5 | 46 | 6 | 34 | 40 |
| .1 | 48 | 8 | 32 | 40 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 33 | 3 | 26 | 30 |
| .5 | 35 | 5 | 25 | 30 |
| .1 | 37 | 7 | 23 | 30 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 44 | 4 | 36 | 40 |
| .5 | 46 | 6 | 34 | 40 |
| .1 | 48 | 8 | 32 | 40 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 34 | 4 | 26 | 30 |
| .5 | 36 | 6 | 24 | 30 |

| | | | | |
|---|---|---|---|---|
| .1 | 38 | 8 | 22 | 30 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 34 | 4 | 26 | 30 |
| .5 | 36 | 6 | 24 | 30 |
| .1 | 38 | 8 | 22 | 30 |

Consequence: Iso 7 late Man ru (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 68 | 7 | 53 | 60 |
| .5 | 71 | 11 | 49 | 60 |
| .1 | 75 | 15 | 45 | 60 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 98 | 8 | 82 | 90 |
| .5 | 102 | 12 | 78 | 90 |
| .1 | 107 | 17 | 73 | 90 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 78 | 7 | 63 | 70 |
| .5 | 81 | 11 | 59 | 70 |
| .1 | 85 | 15 | 55 | 70 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 98 | 8 | 82 | 90 |
| .5 | 102 | 12 | 78 | 90 |
| .1 | 107 | 17 | 73 | 90 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 98 | 8 | 82 | 90 |
| .5 | 102 | 12 | 78 | 90 |
| .1 | 107 | 17 | 73 | 90 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 88 | 7 | 73 | 80 |
| .5 | 92 | 12 | 68 | 80 |
| .1 | 96 | 16 | 64 | 80 |

Consequence: Iso 7 late No 22 (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 22 | 2 | 17 | 20 |
| .5 | 24 | 4 | 16 | 20 |
| .1 | 25 | 5 | 14 | 20 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 22 | 2 | 17 | 20 |
| .5 | 24 | 4 | 16 | 20 |
| .1 | 25 | 5 | 14 | 20 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 22 | 2 | 17 | 20 |
| .5 | 24 | 4 | 16 | 20 |
| .1 | 25 | 5 | 14 | 20 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 22 | 2 | 17 | 20 |
| .5 | 24 | 4 | 16 | 20 |
| .1 | 25 | 5 | 14 | 20 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 22 | 2 | 17 | 20 |
| .5 | 24 | 4 | 16 | 20 |
| .1 | 25 | 5 | 14 | 20 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 22 | 2 | 17 | 20 |
| .5 | 24 | 4 | 16 | 20 |
| .1 | 25 | 5 | 14 | 20 |

Consequence: Iso 7 late No 70 (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 33 | 3 | 26 | 30 |
| .5 | 35 | 5 | 25 | 30 |
| .1 | 37 | 7 | 23 | 30 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 44 | 4 | 36 | 40 |
| .5 | 46 | 6 | 34 | 40 |
| .1 | 48 | 8 | 32 | 40 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 33 | 3 | 26 | 30 |
| .5 | 35 | 5 | 25 | 30 |
| .1 | 37 | 7 | 23 | 30 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 44 | 4 | 36 | 40 |
| .5 | 46 | 6 | 34 | 40 |

| | | | | |
|---|---|---|---|---|
| .1 | 48 | 8 | 32 | 40 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 34 | 4 | 26 | 30 |
| .5 | 36 | 6 | 24 | 30 |
| .1 | 38 | 8 | 22 | 30 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 34 | 4 | 26 | 30 |
| .5 | 36 | 6 | 24 | 30 |
| .1 | 38 | 8 | 22 | 30 |

Consequence: Iso 7 late No ru (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 68 | 7 | 53 | 60 |
| .5 | 71 | 11 | 49 | 60 |
| .1 | 75 | 15 | 45 | 60 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 98 | 8 | 82 | 90 |
| .5 | 102 | 12 | 78 | 90 |
| .1 | 107 | 17 | 73 | 90 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 78 | 7 | 63 | 70 |
| .5 | 81 | 11 | 59 | 70 |
| .1 | 85 | 15 | 55 | 70 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 98 | 8 | 82 | 90 |
| .5 | 102 | 12 | 78 | 90 |
| .1 | 107 | 17 | 73 | 90 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 98 | 8 | 82 | 90 |
| .5 | 102 | 12 | 78 | 90 |
| .1 | 107 | 17 | 73 | 90 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 88 | 7 | 73 | 80 |
| .5 | 92 | 12 | 68 | 80 |
| .1 | 96 | 16 | 64 | 80 |

Consequence: Iso 7 poolf Man 22 (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 40 | 29 | -18 | 11 |
| .5 | 59 | 47 | -35 | 11 |
| .1 | 89 | 77 | -66 | 11 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 41 | 28 | -17 | 12 |
| .5 | 59 | 46 | -33 | 13 |
| .1 | 88 | 75 | -63 | 12 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 42 | 28 | -16 | 12 |
| .5 | 59 | 45 | -32 | 13 |
| .1 | 88 | 74 | -61 | 13 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 43 | 27 | -15 | 14 |
| .5 | 60 | 44 | -30 | 14 |
| .1 | 87 | 71 | -57 | 15 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 44 | 27 | -15 | 14 |
| .5 | 59 | 43 | -29 | 14 |
| .1 | 85 | 70 | -56 | 14 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 44 | 26 | -15 | 15 |
| .5 | 59 | 42 | -28 | 15 |
| .1 | 85 | 68 | -53 | 15 |

Consequence: Iso 7 poolf Man 70 (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 43 | 29 | -15 | 14 |
| .5 | 62 | 47 | -32 | 14 |
| .1 | 91 | 77 | -63 | 14 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 44 | 28 | -14 | 15 |
| .5 | 62 | 46 | -30 | 15 |
| .1 | 91 | 75 | -60 | 15 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 45 | 28 | -14 | 15 |
| .5 | 62 | 45 | -29 | 16 |

| | | | | |
|---|---|---|---|---|
| .1 | 90 | 74 | -59 | 15 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 45 | 27 | -13 | 16 |
| .5 | 62 | 44 | -28 | 17 |
| .1 | 89 | 71 | -54 | 17 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 46 | 27 | -12 | 17 |
| .5 | 62 | 43 | -26 | 17 |
| .1 | 88 | 70 | -53 | 17 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 47 | 26 | -12 | 17 |
| .5 | 62 | 42 | -25 | 18 |
| .1 | 87 | 68 | -51 | 17 |

Consequence: Iso 7 poolf Man 7m (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 20 | 12 | -5 | 7 |
| .5 | 28 | 20 | -13 | 7 |
| .1 | 42 | 34 | -26 | 7 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 18 | 10 | -4 | 7 |
| .5 | 25 | 18 | -10 | 7 |
| .1 | 37 | 29 | -22 | 7 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 20 | 11 | -5 | 7 |
| .5 | 28 | 19 | -11 | 8 |
| .1 | 40 | 32 | -24 | 8 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 19 | 10 | -2 | 8 |
| .5 | 26 | 16 | -8 | 8 |
| .1 | 36 | 27 | -18 | 8 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 21 | 11 | -3 | 8 |
| .5 | 27 | 18 | -9 | 9 |
| .1 | 38 | 29 | -20 | 8 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 20 | 9 | -2 | 9 |
| .5 | 26 | 15 | -7 | 9 |
| .1 | 35 | 25 | -16 | 9 |

Consequence: Iso 7 poolf Man ru (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 47 | 29 | -12 | 17 |
| .5 | 65 | 47 | -29 | 18 |
| .1 | 95 | 77 | -60 | 17 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 47 | 28 | -11 | 17 |
| .5 | 65 | 46 | -27 | 18 |
| .1 | 94 | 75 | -57 | 18 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 48 | 28 | -11 | 18 |
| .5 | 65 | 45 | -27 | 18 |
| .1 | 93 | 74 | -56 | 18 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 51 | 27 | -8 | 21 |
| .5 | 67 | 44 | -22 | 22 |
| .1 | 94 | 71 | -49 | 22 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 51 | 27 | -8 | 21 |
| .5 | 67 | 43 | -21 | 22 |
| .1 | 93 | 70 | -48 | 22 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 51 | 26 | -8 | 21 |
| .5 | 66 | 42 | -21 | 22 |
| .1 | 91 | 68 | -46 | 22 |

Consequence: Iso 7 poolf No 22 (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 40 | 29 | -18 | 11 |
| .5 | 59 | 47 | -35 | 11 |
| .1 | 89 | 77 | -66 | 11 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 41 | 28 | -17 | 12 |
| .5 | 59 | 46 | -33 | 13 |

| | | | | |
|---|---|---|---|---|
| .1 | 88 | 75 | -63 | 12 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 42 | 28 | -16 | 12 |
| .5 | 59 | 45 | -32 | 13 |
| .1 | 88 | 74 | -61 | 13 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 43 | 27 | -15 | 14 |
| .5 | 60 | 44 | -30 | 14 |
| .1 | 87 | 71 | -57 | 15 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 44 | 27 | -15 | 14 |
| .5 | 59 | 43 | -29 | 14 |
| .1 | 85 | 70 | -56 | 14 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 41 | 28 | -17 | 12 |
| .5 | 59 | 46 | -33 | 13 |
| .1 | 88 | 75 | -63 | 12 |

Consequence: Iso 7 poolf No 70 (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 43 | 29 | -15 | 14 |
| .5 | 62 | 47 | -32 | 14 |
| .1 | 91 | 77 | -63 | 14 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 44 | 28 | -14 | 15 |
| .5 | 62 | 46 | -30 | 15 |
| .1 | 91 | 75 | -60 | 15 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 45 | 28 | -14 | 15 |
| .5 | 62 | 45 | -29 | 16 |
| .1 | 90 | 74 | -59 | 15 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 45 | 27 | -13 | 16 |
| .5 | 62 | 44 | -28 | 17 |
| .1 | 89 | 71 | -54 | 17 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 46 | 27 | -12 | 17 |
| .5 | 62 | 43 | -26 | 17 |
| .1 | 88 | 70 | -53 | 17 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 44 | 28 | -14 | 15 |
| .5 | 62 | 46 | -30 | 15 |
| .1 | 91 | 75 | -60 | 15 |

Consequence: Iso 7 poolf No 7m (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 20 | 12 | -5 | 7 |
| .5 | 28 | 20 | -13 | 7 |
| .1 | 42 | 34 | -26 | 7 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 18 | 10 | -4 | 7 |
| .5 | 25 | 18 | -10 | 7 |
| .1 | 37 | 29 | -22 | 7 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 20 | 11 | -5 | 7 |
| .5 | 28 | 19 | -11 | 8 |
| .1 | 40 | 32 | -24 | 8 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 19 | 10 | -2 | 8 |
| .5 | 26 | 16 | -8 | 8 |
| .1 | 36 | 27 | -18 | 8 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 21 | 11 | -3 | 8 |
| .5 | 27 | 18 | -9 | 9 |
| .1 | 38 | 29 | -20 | 8 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 18 | 10 | -4 | 7 |
| .5 | 25 | 18 | -10 | 7 |
| .1 | 37 | 29 | -22 | 7 |

Consequence: Iso 7 poolf No ru (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 47 | 29 | -12 | 17 |
| .5 | 65 | 47 | -29 | 18 |

| | | | | |
|---|---|---|---|---|
| .1 | 95 | 77 | -60 | 17 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 47 | 28 | -11 | 17 |
| .5 | 65 | 46 | -27 | 18 |
| .1 | 94 | 75 | -57 | 18 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 48 | 28 | -11 | 18 |
| .5 | 65 | 45 | -27 | 18 |
| .1 | 93 | 74 | -56 | 18 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 51 | 27 | -8 | 21 |
| .5 | 67 | 44 | -22 | 22 |
| .1 | 94 | 71 | -49 | 22 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 51 | 27 | -8 | 21 |
| .5 | 67 | 43 | -21 | 22 |
| .1 | 93 | 70 | -48 | 22 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 47 | 28 | -11 | 17 |
| .5 | 65 | 46 | -27 | 18 |
| .1 | 94 | 75 | -57 | 18 |

Consequence: Iso 8 late Man 22 (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 24 | 4 | 16 | 20 |
| .5 | 26 | 6 | 14 | 20 |
| .1 | 28 | 8 | 12 | 20 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 34 | 4 | 26 | 30 |
| .5 | 35 | 5 | 25 | 30 |
| .1 | 37 | 7 | 23 | 30 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 24 | 4 | 16 | 20 |
| .5 | 26 | 6 | 14 | 20 |
| .1 | 28 | 8 | 12 | 20 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 34 | 4 | 26 | 30 |
| .5 | 35 | 5 | 25 | 30 |
| .1 | 37 | 7 | 23 | 30 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 34 | 4 | 26 | 30 |
| .5 | 35 | 5 | 25 | 30 |
| .1 | 37 | 7 | 23 | 30 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 34 | 4 | 26 | 30 |
| .5 | 35 | 5 | 25 | 30 |
| .1 | 37 | 7 | 23 | 30 |

Consequence: Iso 8 late Man 70 (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 82 | 12 | 58 | 70 |
| .5 | 88 | 18 | 52 | 70 |
| .1 | 95 | 25 | 45 | 70 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 122 | 12 | 97 | 109 |
| .5 | 127 | 17 | 92 | 109 |
| .1 | 135 | 25 | 85 | 110 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 92 | 12 | 68 | 80 |
| .5 | 98 | 18 | 62 | 80 |
| .1 | 105 | 25 | 55 | 80 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 132 | 12 | 107 | 119 |
| .5 | 138 | 18 | 102 | 120 |
| .1 | 145 | 25 | 95 | 120 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 92 | 12 | 68 | 80 |
| .5 | 98 | 18 | 62 | 80 |
| .1 | 105 | 25 | 55 | 80 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 132 | 12 | 107 | 119 |
| .5 | 138 | 18 | 102 | 120 |
| .1 | 145 | 25 | 95 | 120 |

Consequence: Iso 8 late Man ru (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| .5 | 195 | -15 | 225 | 210 |
| 1 | 183 | 23 | 137 | 160 |
| .1 | 210 | 50 | 110 | 160 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 203 | 23 | 157 | 180 |
| .5 | 215 | 35 | 145 | 180 |
| .1 | 228 | 48 | 132 | 180 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| .5 | 195 | -15 | 225 | 210 |
| 1 | 183 | 23 | 137 | 160 |
| .1 | 210 | 50 | 110 | 160 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 225 | 25 | 175 | 200 |
| .5 | 236 | 36 | 164 | 200 |
| .1 | 250 | 50 | 150 | 200 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 193 | 23 | 147 | 170 |
| .5 | 207 | 37 | 133 | 170 |
| .1 | 220 | 50 | 120 | 170 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 244 | 24 | 196 | 220 |
| .5 | 257 | 47 | 163 | 210 |
| .1 | 270 | 50 | 170 | 220 |

Consequence: Iso 8 late No 22 (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 24 | 4 | 16 | 20 |
| .5 | 26 | 6 | 14 | 20 |
| .1 | 28 | 8 | 12 | 20 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 34 | 4 | 26 | 30 |
| .5 | 35 | 5 | 25 | 30 |
| .1 | 37 | 7 | 23 | 30 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 24 | 4 | 16 | 20 |
| .5 | 26 | 6 | 14 | 20 |
| .1 | 28 | 8 | 12 | 20 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 34 | 4 | 26 | 30 |
| .5 | 35 | 5 | 25 | 30 |
| .1 | 37 | 7 | 23 | 30 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 34 | 4 | 26 | 30 |
| .5 | 35 | 5 | 25 | 30 |
| .1 | 37 | 7 | 23 | 30 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 34 | 4 | 26 | 30 |
| .5 | 35 | 5 | 25 | 30 |
| .1 | 37 | 7 | 23 | 30 |

Consequence: Iso 8 late No 70 (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 82 | 12 | 58 | 70 |
| .5 | 88 | 18 | 52 | 70 |
| .1 | 95 | 25 | 45 | 70 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 122 | 12 | 97 | 109 |
| .5 | 127 | 17 | 92 | 109 |
| .1 | 135 | 25 | 85 | 110 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 92 | 12 | 68 | 80 |
| .5 | 98 | 18 | 62 | 80 |
| .1 | 105 | 25 | 55 | 80 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 132 | 12 | 107 | 119 |
| .5 | 138 | 18 | 102 | 120 |
| .1 | 145 | 25 | 95 | 120 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 92 | 12 | 68 | 80 |
| .5 | 98 | 18 | 62 | 80 |
| .1 | 105 | 25 | 55 | 80 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 132 | 12 | 107 | 119 |
| .5 | 138 | 18 | 102 | 120 |
| .1 | 145 | 25 | 95 | 120 |

Consequence: Iso 8 late No ru (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| .5 | 195 | -15 | 225 | 210 |
| 1 | 183 | 23 | 137 | 160 |
| .1 | 210 | 50 | 110 | 160 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 203 | 23 | 157 | 180 |
| .5 | 215 | 35 | 145 | 180 |
| .1 | 228 | 48 | 132 | 180 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| .5 | 195 | -15 | 225 | 210 |
| 1 | 183 | 23 | 137 | 160 |
| .1 | 210 | 50 | 110 | 160 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 225 | 25 | 175 | 200 |
| .5 | 236 | 36 | 164 | 200 |
| .1 | 250 | 50 | 150 | 200 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 193 | 23 | 147 | 170 |
| .5 | 207 | 37 | 133 | 170 |
| .1 | 220 | 50 | 120 | 170 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 244 | 24 | 196 | 220 |
| .5 | 257 | 47 | 163 | 210 |
| .1 | 270 | 50 | 170 | 220 |

Consequence: Iso 8 poolf Man 22 (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 72 | 38 | -5 | 33 |
| .5 | 95 | 61 | -28 | 33 |
| .1 | 134 | 101 | -67 | 33 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 69 | 28 | 9 | 39 |
| .5 | 87 | 46 | -7 | 40 |
| .1 | 117 | 76 | -37 | 40 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 74 | 36 | -2 | 35 |
| .5 | 95 | 58 | -22 | 36 |
| .1 | 132 | 95 | -59 | 36 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 73 | 25 | 17 | 45 |
| .5 | 87 | 40 | 4 | 46 |
| .1 | 113 | 66 | -20 | 46 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 80 | 31 | 12 | 46 |
| .5 | 97 | 49 | -3 | 47 |
| .1 | 126 | 79 | -33 | 46 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 73 | 21 | 25 | 49 |
| .5 | 85 | 34 | 15 | 50 |
| .1 | 106 | 55 | -5 | 50 |

Consequence: Iso 8 poolf Man 70 (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 175 | 114 | -53 | 60 |
| .5 | 236 | 175 | -113 | 61 |
| .1 | 338 | 277 | -216 | 61 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 167 | 97 | -31 | 67 |
| .5 | 219 | 151 | -83 | 68 |
| .1 | 308 | 239 | -169 | 69 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 173 | 111 | -53 | 60 |
| .5 | 232 | 170 | -109 | 61 |
| .1 | 329 | 270 | -210 | 59 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 171 | 94 | -23 | 73 |
| .5 | 221 | 142 | -67 | 76 |
| .1 | 301 | 224 | -151 | 74 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 188 | 104 | -28 | 80 |
| .5 | 239 | 157 | -77 | 80 |
| .1 | 329 | 246 | -166 | 81 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 174 | 89 | -14 | 80 |
| .5 | 218 | 134 | -54 | 81 |
| .1 | 293 | 209 | -128 | 82 |

Consequence: Iso 8 poolf Man 7m (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 28 | 9 | 7 | 17 |
| .5 | 35 | 16 | 1 | 18 |
| .1 | 46 | 28 | -9 | 18 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 26 | 3 | 18 | 22 |
| .5 | 29 | 6 | 16 | 23 |
| .1 | 33 | 10 | 12 | 23 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 28 | 9 | 8 | 18 |
| .5 | 34 | 15 | 3 | 19 |
| .1 | 44 | 25 | -6 | 19 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 31 | 1 | 26 | 28 |
| .5 | 32 | 3 | 25 | 28 |
| .1 | 34 | 5 | 23 | 29 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 37 | 4 | 27 | 32 |
| .5 | 40 | 7 | 24 | 32 |
| .1 | 45 | 12 | 19 | 32 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 43 | 0 | 41 | 42 |
| .5 | 45 | 1 | 41 | 43 |
| .1 | 46 | 2 | 41 | 43 |

Consequence: Iso 8 poolf Man ru (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 204 | 123 | -44 | 79 |
| .5 | 270 | 189 | -107 | 81 |
| .1 | 380 | 299 | -218 | 80 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 216 | 118 | -24 | 96 |
| .5 | 278 | 181 | -85 | 96 |
| .1 | 382 | 285 | -188 | 97 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 215 | 122 | -32 | 91 |
| .5 | 277 | 185 | -95 | 91 |
| .1 | 384 | 292 | -202 | 91 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 223 | 116 | -15 | 103 |
| .5 | 282 | 174 | -70 | 105 |
| .1 | 379 | 274 | -170 | 104 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 228 | 118 | -15 | 106 |
| .5 | 285 | 177 | -71 | 107 |
| .1 | 383 | 278 | -172 | 105 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 226 | 113 | -11 | 107 |
| .5 | 279 | 168 | -61 | 109 |
| .1 | 371 | 262 | -155 | 108 |

Consequence: Iso 8 poolf No 22 (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 72 | 38 | -5 | 33 |
| .5 | 95 | 61 | -28 | 33 |
| .1 | 134 | 101 | -67 | 33 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 69 | 28 | 9 | 39 |
| .5 | 87 | 46 | -7 | 40 |
| .1 | 117 | 76 | -37 | 40 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 74 | 36 | -2 | 35 |
| .5 | 95 | 58 | -22 | 36 |
| .1 | 132 | 95 | -59 | 36 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 73 | 25 | 17 | 45 |
| .5 | 87 | 40 | 4 | 46 |
| .1 | 113 | 66 | -20 | 46 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 80 | 31 | 12 | 46 |
| .5 | 97 | 49 | -3 | 47 |
| .1 | 126 | 79 | -33 | 46 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 69 | 28 | 9 | 39 |
| .5 | 87 | 46 | -7 | 40 |
| .1 | 117 | 76 | -37 | 40 |

Consequence: Iso 8 poolf No 70 (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 174 | 113 | -53 | 60 |
| .5 | 235 | 174 | -113 | 61 |
| .1 | 337 | 276 | -215 | 60 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 166 | 97 | -31 | 67 |
| .5 | 219 | 150 | -83 | 68 |
| .1 | 307 | 238 | -169 | 69 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 174 | 111 | -52 | 61 |
| .5 | 232 | 169 | -109 | 61 |
| .1 | 328 | 269 | -209 | 59 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 171 | 93 | -22 | 74 |
| .5 | 220 | 142 | -67 | 76 |
| .1 | 300 | 224 | -151 | 74 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 187 | 103 | -28 | 79 |
| .5 | 240 | 156 | -75 | 82 |
| .1 | 328 | 245 | -165 | 81 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|

| | | | | |
|---|---|---|---|---|
| 1 | 166 | 97 | -31 | 67 |
| .5 | 219 | 150 | -83 | 68 |
| .1 | 307 | 238 | -169 | 69 |

Consequence: Iso 8 poolf No 7m (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 28 | 9 | 7 | 17 |
| .5 | 35 | 16 | 1 | 18 |
| .1 | 46 | 28 | -9 | 18 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 26 | 3 | 18 | 22 |
| .5 | 29 | 6 | 16 | 23 |
| .1 | 33 | 10 | 12 | 23 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 28 | 9 | 8 | 18 |
| .5 | 34 | 15 | 3 | 19 |
| .1 | 44 | 25 | -6 | 19 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 31 | 1 | 26 | 28 |
| .5 | 32 | 3 | 25 | 28 |
| .1 | 34 | 5 | 23 | 29 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 37 | 4 | 27 | 32 |
| .5 | 40 | 7 | 24 | 32 |
| .1 | 45 | 12 | 19 | 32 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 26 | 3 | 18 | 22 |
| .5 | 29 | 6 | 16 | 23 |
| .1 | 33 | 10 | 12 | 23 |

Consequence: Iso 8 poolf No ru (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 204 | 123 | -43 | 80 |
| .5 | 269 | 188 | -107 | 81 |
| .1 | 378 | 298 | -217 | 80 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 215 | 117 | -23 | 95 |
| .5 | 277 | 180 | -85 | 96 |
| .1 | 381 | 284 | -187 | 96 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 214 | 121 | -32 | 91 |
| .5 | 276 | 184 | -94 | 90 |
| .1 | 383 | 290 | -201 | 90 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 223 | 115 | -14 | 104 |
| .5 | 281 | 174 | -70 | 105 |
| .1 | 377 | 273 | -169 | 103 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 227 | 117 | -15 | 105 |
| .5 | 284 | 176 | -71 | 106 |
| .1 | 382 | 276 | -171 | 105 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 215 | 117 | -23 | 95 |
| .5 | 277 | 180 | -85 | 96 |
| .1 | 381 | 284 | -187 | 96 |

Consequence: Iso 9 late Man 22 (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 13 | 3 | 6 | 9 |
| .5 | 15 | 5 | 5 | 10 |
| .1 | 17 | 7 | 3 | 10 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 24 | 4 | 16 | 20 |
| .5 | 26 | 6 | 14 | 20 |
| .1 | 28 | 8 | 12 | 20 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 13 | 3 | 6 | 9 |
| .5 | 15 | 5 | 5 | 10 |
| .1 | 17 | 7 | 3 | 10 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 24 | 4 | 16 | 20 |
| .5 | 26 | 6 | 14 | 20 |
| .1 | 28 | 8 | 12 | 20 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|

| | | | | |
|---|---|---|---|---|
| 1 | 13 | 3 | 6 | 9 |
| .5 | 15 | 5 | 5 | 10 |
| .1 | 17 | 7 | 3 | 10 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 13 | 3 | 6 | 9 |
| .5 | 15 | 5 | 5 | 10 |
| .1 | 17 | 7 | 3 | 10 |

Consequence: Iso 9 late Man 70 (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 97 | 7 | 83 | 90 |
| .5 | 100 | 10 | 80 | 90 |
| .1 | 105 | 15 | 75 | 90 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 120 | 10 | 100 | 110 |
| .5 | 124 | 14 | 96 | 110 |
| .1 | 130 | 20 | 90 | 110 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 97 | 7 | 83 | 90 |
| .5 | 100 | 10 | 80 | 90 |
| .1 | 105 | 15 | 75 | 90 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 88 | 8 | 72 | 80 |
| .5 | 92 | 12 | 68 | 80 |
| .1 | 97 | 17 | 63 | 80 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 68 | 7 | 53 | 60 |
| .5 | 71 | 11 | 49 | 60 |
| .1 | 75 | 15 | 45 | 60 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 78 | 8 | 62 | 70 |
| .5 | 82 | 12 | 58 | 70 |
| .1 | 86 | 16 | 54 | 70 |

Consequence: Iso 9 late Man ru (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 288 | 18 | 252 | 270 |
| .5 | 298 | 28 | 242 | 270 |
| .1 | 310 | 40 | 230 | 270 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 244 | 24 | 196 | 220 |
| .5 | 257 | 37 | 183 | 220 |
| .1 | 270 | 50 | 170 | 220 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 205 | 15 | 175 | 190 |
| .5 | 212 | 22 | 168 | 190 |
| .1 | 220 | 30 | 160 | 190 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 195 | 15 | 165 | 180 |
| .5 | 200 | 20 | 160 | 180 |
| .1 | 210 | 30 | 150 | 180 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 150 | 11 | 128 | 139 |
| .5 | 158 | 18 | 122 | 140 |
| .1 | 165 | 25 | 115 | 140 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 152 | 12 | 128 | 140 |
| .5 | 160 | 20 | 120 | 140 |
| .1 | 168 | 28 | 112 | 140 |

Consequence: Iso 9 late No 22 (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 13 | 3 | 6 | 9 |
| .5 | 15 | 5 | 5 | 10 |
| .1 | 17 | 7 | 3 | 10 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 24 | 4 | 16 | 20 |
| .5 | 26 | 6 | 14 | 20 |
| .1 | 28 | 8 | 12 | 20 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 13 | 3 | 6 | 9 |
| .5 | 15 | 5 | 5 | 10 |
| .1 | 17 | 7 | 3 | 10 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|

| | | | | |
|---|---|---|---|---|
| 1 | 24 | 4 | 16 | 20 |
| .5 | 26 | 6 | 14 | 20 |
| .1 | 28 | 8 | 12 | 20 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 13 | 3 | 6 | 9 |
| .5 | 15 | 5 | 5 | 10 |
| .1 | 17 | 7 | 3 | 10 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 13 | 3 | 6 | 9 |
| .5 | 15 | 5 | 5 | 10 |
| .1 | 17 | 7 | 3 | 10 |

Consequence: Iso 9 late No 70 (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 97 | 7 | 83 | 90 |
| .5 | 100 | 10 | 80 | 90 |
| .1 | 105 | 15 | 75 | 90 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 120 | 10 | 100 | 110 |
| .5 | 124 | 14 | 96 | 110 |
| .1 | 130 | 20 | 90 | 110 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 97 | 7 | 83 | 90 |
| .5 | 100 | 10 | 80 | 90 |
| .1 | 105 | 15 | 75 | 90 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 88 | 8 | 72 | 80 |
| .5 | 92 | 12 | 68 | 80 |
| .1 | 97 | 17 | 63 | 80 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 68 | 7 | 53 | 60 |
| .5 | 71 | 11 | 49 | 60 |
| .1 | 75 | 15 | 45 | 60 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 78 | 8 | 62 | 70 |
| .5 | 82 | 12 | 58 | 70 |
| .1 | 86 | 16 | 54 | 70 |

Consequence: Iso 9 late No ru (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 288 | 18 | 252 | 270 |
| .5 | 298 | 28 | 242 | 270 |
| .1 | 310 | 40 | 230 | 270 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 244 | 24 | 196 | 220 |
| .5 | 257 | 37 | 183 | 220 |
| .1 | 270 | 50 | 170 | 220 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 205 | 15 | 175 | 190 |
| .5 | 212 | 22 | 168 | 190 |
| .1 | 220 | 30 | 160 | 190 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 195 | 15 | 165 | 180 |
| .5 | 200 | 20 | 160 | 180 |
| .1 | 210 | 30 | 150 | 180 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 150 | 11 | 128 | 139 |
| .5 | 158 | 18 | 122 | 140 |
| .1 | 165 | 25 | 115 | 140 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 152 | 12 | 128 | 140 |
| .5 | 160 | 20 | 120 | 140 |
| .1 | 168 | 28 | 112 | 140 |

Consequence: Iso 9 poolf Man 22 (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 45 | 29 | -13 | 15 |
| .5 | 64 | 47 | -30 | 16 |
| .1 | 94 | 77 | -61 | 16 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 47 | 28 | -11 | 17 |
| .5 | 65 | 46 | -27 | 18 |
| .1 | 94 | 75 | -56 | 19 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|

| | | | | |
|---|---|---|---|---|
| 1 | 47 | 28 | -11 | 17 |
| .5 | 64 | 45 | -27 | 18 |
| .1 | 93 | 74 | -56 | 18 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 51 | 27 | -8 | 21 |
| .5 | 67 | 44 | -22 | 22 |
| .1 | 94 | 71 | -49 | 22 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 51 | 27 | -8 | 21 |
| .5 | 67 | 43 | -21 | 22 |
| .1 | 93 | 70 | -48 | 22 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 52 | 26 | -7 | 22 |
| .5 | 67 | 42 | -20 | 23 |
| .1 | 92 | 68 | -45 | 23 |

Consequence: Iso 9 poolf Man 70 (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 161 | 130 | -100 | 30 |
| .5 | 228 | 198 | -168 | 29 |
| .1 | 344 | 313 | -282 | 31 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 156 | 118 | -84 | 36 |
| .5 | 218 | 181 | -145 | 36 |
| .1 | 322 | 285 | -248 | 37 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 164 | 128 | -94 | 35 |
| .5 | 229 | 193 | -159 | 35 |
| .1 | 339 | 304 | -272 | 33 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 159 | 115 | -78 | 40 |
| .5 | 218 | 174 | -133 | 42 |
| .1 | 315 | 274 | -233 | 41 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 170 | 123 | -83 | 43 |
| .5 | 230 | 184 | -141 | 44 |
| .1 | 331 | 288 | -245 | 43 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 161 | 112 | -75 | 42 |
| .5 | 214 | 168 | -125 | 44 |
| .1 | 307 | 261 | -218 | 44 |

Consequence: Iso 9 poolf Man 7m (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 25 | 14 | -4 | 10 |
| .5 | 34 | 23 | -13 | 10 |
| .1 | 50 | 39 | -28 | 10 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 23 | 11 | -1 | 11 |
| .5 | 31 | 19 | -8 | 11 |
| .1 | 44 | 32 | -21 | 11 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 25 | 13 | -3 | 10 |
| .5 | 33 | 22 | -11 | 11 |
| .1 | 48 | 36 | -25 | 11 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 24 | 10 | 0 | 12 |
| .5 | 31 | 17 | -5 | 13 |
| .1 | 42 | 29 | -16 | 13 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 27 | 11 | 0 | 14 |
| .5 | 34 | 19 | -5 | 14 |
| .1 | 47 | 31 | -17 | 14 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 26 | 9 | 4 | 15 |
| .5 | 32 | 15 | 0 | 15 |
| .1 | 41 | 25 | -10 | 15 |

Consequence: Iso 9 poolf Man ru (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 393 | 346 | -302 | 45 |
| .5 | 548 | 502 | -457 | 45 |
| .1 | 814 | 766 | -722 | 46 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|

| | | | | |
|---|---|---|---|---|
| 1 | 377 | 320 | -267 | 54 |
| .5 | 520 | 463 | -409 | 55 |
| .1 | 761 | 704 | -648 | 56 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 400 | 343 | -290 | 55 |
| .5 | 550 | 494 | -441 | 54 |
| .1 | 807 | 754 | -701 | 52 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 388 | 314 | -248 | 70 |
| .5 | 525 | 450 | -380 | 72 |
| .1 | 758 | 683 | -608 | 75 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 410 | 334 | -267 | 71 |
| .5 | 553 | 479 | -408 | 72 |
| .1 | 799 | 725 | -653 | 72 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 388 | 309 | -243 | 72 |
| .5 | 518 | 441 | -367 | 75 |
| .1 | 737 | 662 | -591 | 73 |

Consequence: Iso 9 poolf No 22 (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 45 | 29 | -13 | 15 |
| .5 | 64 | 47 | -30 | 16 |
| .1 | 94 | 77 | -61 | 16 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 47 | 28 | -11 | 17 |
| .5 | 65 | 46 | -27 | 18 |
| .1 | 94 | 75 | -56 | 19 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 47 | 28 | -11 | 17 |
| .5 | 64 | 45 | -27 | 18 |
| .1 | 93 | 74 | -56 | 18 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 51 | 27 | -8 | 21 |
| .5 | 67 | 44 | -22 | 22 |
| .1 | 94 | 71 | -49 | 22 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 51 | 27 | -8 | 21 |
| .5 | 67 | 43 | -21 | 22 |
| .1 | 93 | 70 | -48 | 22 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 47 | 28 | -11 | 17 |
| .5 | 65 | 46 | -27 | 18 |
| .1 | 94 | 75 | -56 | 19 |

Consequence: Iso 9 poolf No 70 (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 161 | 130 | -100 | 30 |
| .5 | 228 | 198 | -168 | 29 |
| .1 | 344 | 313 | -282 | 31 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 156 | 118 | -84 | 36 |
| .5 | 218 | 181 | -145 | 36 |
| .1 | 322 | 285 | -248 | 37 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 164 | 128 | -94 | 35 |
| .5 | 229 | 193 | -159 | 35 |
| .1 | 339 | 304 | -272 | 33 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 159 | 115 | -78 | 40 |
| .5 | 218 | 174 | -133 | 42 |
| .1 | 315 | 274 | -233 | 41 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 170 | 123 | -83 | 43 |
| .5 | 230 | 184 | -141 | 44 |
| .1 | 331 | 288 | -245 | 43 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 156 | 118 | -84 | 36 |
| .5 | 218 | 181 | -145 | 36 |
| .1 | 322 | 285 | -248 | 37 |

Consequence: Iso 9 poolf No 7m (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|

| | | | | |
|---|---|---|---|---|
| 1 | 25 | 14 | -4 | 10 |
| .5 | 34 | 23 | -13 | 10 |
| .1 | 50 | 39 | -28 | 10 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 23 | 11 | -1 | 11 |
| .5 | 31 | 19 | -8 | 11 |
| .1 | 44 | 32 | -21 | 11 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 25 | 13 | -3 | 10 |
| .5 | 33 | 22 | -11 | 11 |
| .1 | 48 | 36 | -25 | 11 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 24 | 10 | 0 | 12 |
| .5 | 31 | 17 | -5 | 13 |
| .1 | 42 | 29 | -16 | 13 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 27 | 11 | 0 | 14 |
| .5 | 34 | 19 | -5 | 14 |
| .1 | 47 | 31 | -17 | 14 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 23 | 11 | -1 | 11 |
| .5 | 31 | 19 | -8 | 11 |
| .1 | 44 | 32 | -21 | 11 |

Consequence: Iso 9 poolf No ru (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 393 | 346 | -302 | 45 |
| .5 | 548 | 502 | -457 | 45 |
| .1 | 814 | 766 | -722 | 46 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 377 | 320 | -267 | 54 |
| .5 | 520 | 463 | -409 | 55 |
| .1 | 761 | 704 | -648 | 56 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 400 | 343 | -290 | 55 |
| .5 | 550 | 494 | -441 | 54 |
| .1 | 807 | 754 | -701 | 52 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 388 | 314 | -248 | 70 |
| .5 | 525 | 450 | -380 | 72 |
| .1 | 758 | 683 | -608 | 75 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 410 | 334 | -267 | 71 |
| .5 | 553 | 479 | -408 | 72 |
| .1 | 799 | 725 | -653 | 72 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 377 | 320 | -267 | 54 |
| .5 | 520 | 463 | -409 | 55 |
| .1 | 761 | 704 | -648 | 56 |

Consequence: Tox i4 70mm (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| .5 | 65 | 6 | 0 | 60 |
| .1 | 75 | 9 | 0 | 60 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| .5 | 65 | 6 | 0 | 60 |
| .1 | 75 | 9 | 0 | 60 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| .5 | 65 | 6 | 0 | 60 |
| .1 | 75 | 9 | 0 | 60 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| .5 | 65 | 6 | 0 | 60 |
| .1 | 75 | 9 | 0 | 60 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| .5 | 65 | 6 | 0 | 60 |
| .1 | 75 | 9 | 0 | 60 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| .5 | 65 | 6 | 0 | 60 |
| .1 | 75 | 9 | 0 | 60 |

Consequence: Tox i4 rup (unaffected by topography)

Weather state: 1.8F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 56 | 3 | 0 | 35 |
| .5 | 135 | 12 | 0 | 110 |
| .1 | 155 | 21 | 0 | 130 |

Weather state: 2.5B

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 56 | 3 | 0 | 35 |
| .5 | 135 | 12 | 0 | 10 |
| .1 | 155 | 21 | 0 | 130 |

Weather state: 3.0F

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 56 | 3 | 0 | 35 |
| .5 | 135 | 12 | 0 | 110 |
| .1 | 155 | 21 | 0 | 130 |

Weather state: 4.2C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 56 | 3 | 0 | 35 |
| .5 | 135 | 12 | 0 | 110 |
| .1 | 155 | 21 | 0 | 130 |

Weather state: 5.1D

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 56 | 3 | 0 | 35 |
| .5 | 135 | 12 | 0 | 110 |
| .1 | 155 | 21 | 0 | 130 |

Weather state: 6.3C

| Fatality prob | d | c | s | m |
|---|---|---|---|---|
| 1 | 56 | 3 | 0 | 35 |
| .5 | 135 | 12 | 0 | 110 |
| .1 | 155 | 21 | 0 | 130 |

Hazards

Hazard: iso 1

Coordinates:

| | |
|---|---|
| 78046 | 22866 |
| 78067 | 22868 |
| 78068 | 22858 |
| 78047 | 22855 |

Consequences:

| | Day | Night |
|---|---|---|
| Iso 1 BLEVE Man ru | .0000000000226 | .0000000000226 |
| Iso 1 BLEVE No ru | .000000000000228 | .000000000000228 |
| Iso 1 jetfi Man 22 | .0000000000226 | .0000000000226 |
| Iso 1 jetfi Man 70 | .0000000000226 | .0000000000226 |
| Iso 1 jetfi Man 7m | .0000000000226 | .0000000000226 |
| Iso 1 jetfi Man ru | .0000000000226 | .0000000000226 |
| Iso 1 jetfi No 22 | .0000003 | .0000003 |
| Iso 1 jetfi No 70 | .000000321 | .000000321 |

| | | |
|---|---|---|
| Iso 1 jetfi No 7m | .00000044 | .00000044 |
| Iso 1 jetfi No ru | .0000000000226 | .0000000000226 |
| Iso 1 late Man 70 | .00000176 | .00000176 |
| Iso 1 late Man ru | .0000000000226 | .0000000000226 |
| Iso 1 late No 70 | .0000000356 | .0000000356 |
| Iso 1 late No ru | .000000000000228 | .000000000000228 |

Hazard: iso 10 N

Coordinates:
78129 22841
78140 22842
78141 22832
78131 22831

Consequences:

| | Day | Night |
|---|---|---|
| Iso 10 late Man 22 | .0000000121 | .0000000121 |
| Iso 10 late Man 70 | .0000000151 | .0000000151 |
| Iso 10 late No 22 | .000000000123 | .000000000123 |
| Iso 10 late No 70 | .000000000153 | .000000000153 |
| Iso 10 poolf Man 22 | .0000012 | .0000012 |
| Iso 10 poolf Man 70 | .0000015 | .0000015 |
| Iso 10 poolf Man 7m | .00000175 | .00000175 |
| Iso 10 poolf No 22 | .0000000121 | .0000000121 |
| Iso 10 poolf No 70 | .0000000151 | .0000000151 |
| Iso 10 poolf No 7m | .0000000177 | .0000000177 |

Hazard: iso 10 S

Coordinates:
78150 22843
78160 22844
78161 22834
78151 22833

Consequences:

| | Day | Night |
|---|---|---|
| Iso 10 late Man 22 | .0000000121 | .0000000121 |
| Iso 10 late Man 70 | .0000000151 | .0000000151 |
| Iso 10 late No 22 | .000000000123 | .000000000123 |
| Iso 10 late No 70 | .000000000153 | .000000000153 |
| Iso 10 poolf Man 22 | .0000012 | .0000012 |
| Iso 10 poolf Man 70 | .0000015 | .0000015 |
| Iso 10 poolf Man 7m | .00000175 | .00000175 |
| Iso 10 poolf No 22 | .0000000121 | .0000000121 |
| Iso 10 poolf No 70 | .0000000151 | .0000000151 |
| Iso 10 poolf No 7m | .0000000177 | .0000000177 |

Hazard: iso 11

Coordinates:
78170 22845
78176 22846
78181 22799
78230 22805
78230 22800
78176 22794

Consequences:

| | Day | Night |
|---|---|---|

| | | |
|---|---|---|
| Iso 11 BLEVE No ru | .00000000000419 | .00000000000419 |
| Iso 11 late Man 70 | .000000000414 | .000000000414 |
| Iso 11 late Man ru | .000000000414 | .000000000414 |
| Iso 11 late No 70 | .000000000875 | .000000000875 |
| Iso 11 late No ru | .00000000000419 | .00000000000419 |
| Iso 11 poolf Man 22 | .00000464 | .00000464 |
| Iso 11 poolf Man 70 | .00000857 | .00000857 |
| Iso 11 poolf Man 7m | .00000194 | .00000194 |
| Iso 11 poolf Man ru | .000000041 | .000000041 |
| Iso 11 poolf No 22 | .0000000469 | .0000000469 |
| Iso 11 poolf No 70 | .0000000866 | .0000000866 |
| Iso 11 poolf No 7m | .0000000196 | .0000000196 |
| Iso 11 poolf No ru | .000000000414 | .000000000414 |

Hazard: iso 12 N

Coordinates:

| | |
|---|---|
| 78212 | 22868 |
| 78236 | 22870 |
| 78250 | 22856 |
| 78252 | 22836 |
| 78241 | 22822 |
| 78218 | 22819 |
| 78201 | 22830 |
| 78199 | 22851 |

Consequences:

| | Day | Night |
|---|---|---|
| Iso 12 late Man 22 | .0000000388 | .0000000388 |
| Iso 12 late Man 70 | .0000000496 | .0000000496 |
| Iso 12 late No 22 | .000000000392 | .000000000392 |
| Iso 12 late No 70 | .000000000501 | .000000000501 |
| Iso 12 poolf Man 22 | .00000384 | .00000384 |
| Iso 12 poolf Man 70 | .00000491 | .00000491 |
| Iso 12 poolf Man 7m | .00000528 | .00000528 |
| Iso 12 poolf No 22 | .0000000388 | .0000000388 |
| Iso 12 poolf No 70 | .0000000496 | .0000000496 |
| Iso 12 poolf No 7m | .0000000533 | .0000000533 |

Hazard: iso 12 S

Coordinates:

| | |
|---|---|
| 78221 | 22788 |
| 78244 | 22791 |
| 78259 | 22777 |
| 78261 | 22756 |
| 78249 | 22742 |
| 78226 | 22739 |
| 78209 | 22750 |
| 78207 | 22771 |

Consequences:

| | Day | Night |
|---|---|---|
| Iso 12 late Man 22 | .0000000388 | .0000000388 |
| Iso 12 late Man 70 | .0000000496 | .0000000496 |
| Iso 12 late No 22 | .000000000392 | .000000000392 |
| Iso 12 late No 70 | .000000000501 | .000000000501 |
| Iso 12 poolf Man 22 | .00000384 | .00000384 |
| Iso 12 poolf Man 70 | .00000491 | .00000491 |
| Iso 12 poolf Man 7m | .00000528 | .00000528 |
| Iso 12 poolf No 22 | .0000000388 | .0000000388 |
| Iso 12 poolf No 70 | .0000000496 | .0000000496 |
| Iso 12 poolf No 7m | .0000000533 | .0000000533 |

Hazard: iso 13

Coordinates:

| | |
|---|---|
| 78230 | 22802 |
| 78178 | 22797 |
| 78179 | 22791 |

Consequences:

| | Day | Night |
|---|---|---|
| Iso 13 late Man 22 | .0000000281 | .0000000281 |
| Iso 13 late Man 70 | .0000000495 | .0000000495 |
| Iso 13 late Man ru | .000000000104 | .000000000104 |
| Iso 13 late No 22 | .000000000284 | .000000000284 |
| Iso 13 late No 70 | .0000000005 | .0000000005 |
| Iso 13 late No ru | .00000000000105 | .00000000000105 |
| Iso 13 poolf Man 22 | .00000278 | .00000278 |
| Iso 13 poolf Man 70 | .0000049 | .0000049 |
| Iso 13 poolf Man 7m | .00000119 | .00000119 |
| Iso 13 poolf Man ru | .0000000103 | .0000000103 |
| Iso 13 poolf No 22 | .0000000281 | .0000000281 |
| Iso 13 poolf No 70 | .0000000495 | .0000000495 |
| Iso 13 poolf No 7m | .000000012 | .000000012 |
| Iso 13 poolf No ru | .000000000104 | .000000000104 |

Hazard: iso 14

Coordinates:

| | |
|---|---|
| 78127 | 22861 |
| 78137 | 22863 |
| 78138 | 22852 |
| 78128 | 22851 |

Consequences:

| | Day | Night |
|---|---|---|
| Iso 14 late Man 22 | .00000000439 | .00000000439 |
| Iso 14 late Man 70 | .00000000834 | .00000000834 |
| Iso 14 late No 22 | .0000000000444 | .0000000000444 |
| Iso 14 late No 70 | .0000000000843 | .0000000000843 |
| Iso 14 poolf Man 22 | .000000435 | .000000435 |
| Iso 14 poolf Man 70 | .000000826 | .000000826 |
| Iso 14 poolf Man 7m | .000000181 | .000000181 |
| Iso 14 poolf No 22 | .00000000439 | .00000000439 |
| Iso 14 poolf No 70 | .00000000834 | .00000000834 |
| Iso 14 poolf No 7m | .00000000183 | .00000000183 |

Hazard: iso 15

Coordinates:

| | |
|---|---|
| 78113 | 22803 |
| 78174 | 22809 |
| 78169 | 22856 |

Consequences:

| | Day | Night |
|---|---|---|
| Iso 15 late Man 22 | .00000000309 | .00000000309 |
| Iso 15 late Man 70 | .0000000076 | .0000000076 |
| Iso 15 late No 22 | .0000000000312 | .0000000000312 |
| Iso 15 late No 70 | .0000000000767 | .0000000000767 |
| Iso 15 poolf Man 22 | .000000306 | .000000306 |
| Iso 15 poolf Man 70 | .000000752 | .000000752 |
| Iso 15 poolf Man 7m | .000000177 | .000000177 |
| Iso 15 poolf No 22 | .00000000309 | .00000000309 |
| Iso 15 poolf No 70 | .0000000076 | .0000000076 |
| Iso 15 poolf No 7m | .00000000179 | .00000000179 |

Hazard: iso 16

Coordinates:
73700 20400

Consequences:

| | Day | Night |
|---|---|---|
| Iso 16 late Man 22 | .000000000527 | .000000000527 |
| Iso 16 late Man 70 | .00000000138 | .00000000138 |
| Iso 16 late No 22 | .00000000000533 | .00000000000533 |
| Iso 16 late No 70 | .000000000014 | .000000000014 |
| Iso 16 poolf Man 22 | .0000000522 | .0000000522 |
| Iso 16 poolf Man 70 | .000000137 | .000000137 |
| Iso 16 poolf Man 7m | .0000000302 | .0000000302 |
| Iso 16 poolf No 22 | .000000000527 | .000000000527 |
| Iso 16 poolf No 70 | .00000000138 | .00000000138 |
| Iso 16 poolf No 7m | .000000000305 | .000000000305 |

Hazard: iso 17

Coordinates:
73200 20200

Consequences:

| | Day | Night |
|---|---|---|
| Iso 17 poolf Man 22 | .00000142 | .00000142 |
| Iso 17 poolf Man 70 | .00000139 | .00000139 |
| Iso 17 poolf Man 7m | .00000307 | .00000307 |
| Iso 17 poolf Man ru | .0000000103 | .0000000103 |
| Iso 17 poolf No 22 | .0000000144 | .0000000144 |
| Iso 17 poolf No 70 | .000000014 | .000000014 |
| Iso 17 poolf No 7m | .000000031 | .000000031 |
| Iso 17 poolf No ru | .000000000104 | .000000000104 |

Hazard: iso 18

Coordinates:
77042 23167
76400 21206
76500 20958
75958 20125
75750 19333
73900 20250
73500 20166
73709 20333

Consequences:

| | Day | Night |
|---|---|---|
| Iso 18 "idl late Man 22 | .00000002 | .00000002 |
| Iso 18 "idl late Man 70 | .0000000425 | .0000000425 |
| Iso 18 "idl late Man ru | .00000000591 | .00000000591 |
| Iso 18 "idl late No 22 | .000000000202 | .000000000202 |
| Iso 18 "idl late No 70 | .000000000429 | .000000000429 |
| Iso 18 "idl late No ru | .0000000000597 | .0000000000597 |
| Iso 18 "idl poolf Man 22 | .00000198 | .00000198 |
| Iso 18 "idl poolf Man 70 | .00000421 | .00000421 |
| Iso 18 "idl poolf Man 7m | .00000308 | .00000308 |
| Iso 18 "idl poolf Man ru | .000000585 | .000000585 |
| Iso 18 "idl poolf No 22 | .00000002 | .00000002 |
| Iso 18 "idl poolf No 70 | .0000000425 | .0000000425 |
| Iso 18 "idl poolf No 7m | .0000000311 | .0000000311 |
| Iso 18 "idl poolf No ru | .00000000591 | .00000000591 |
| Iso 18 "op" late Man 22 | .00000000222 | .00000000222 |

| | | |
|---|---|---|
| Iso 18 "op" late Man 70 | .00000000472 | .00000000472 |
| Iso 18 "op" late Man ru | .000000000657 | .000000000657 |
| Iso 18 "op" late No 22 | .0000000000224 | .0000000000224 |
| Iso 18 "op" late No 70 | .0000000000477 | .0000000000477 |
| Iso 18 "op" late No ru | .00000000000663 | .00000000000663 |
| Iso 18 "op" poolf Man 22 | .00000022 | .00000022 |
| Iso 18 "op" poolf Man 70 | .000000468 | .000000468 |
| Iso 18 "op" poolf Man 7m | .000000342 | .000000342 |
| Iso 18 "op" poolf Man ru | .000000065 | .000000065 |
| Iso 18 "op" poolf No 22 | .00000000222 | .00000000222 |
| Iso 18 "op" poolf No 70 | .00000000472 | .00000000472 |
| Iso 18 "op" poolf No 7m | .00000000346 | .00000000346 |
| Iso 18 "op" poolf No ru | .000000000657 | .000000000657 |

Hazard: iso 2

Coordinates:
78068 22853
78102 22856
78103 22838
78070 22834

Consequences:

| | Day | Night |
|---|---|---|
| Iso 2 jetfi Man 22 | .00000616 | .00000616 |
| Iso 2 jetfi Man 70 | .0000105 | .0000105 |
| Iso 2 jetfi Man 7m | .00000382 | .00000382 |
| Iso 2 jetfi Man ru | .0000000085 | .0000000085 |
| Iso 2 jetfi No 22 | .0000000622 | .0000000622 |
| Iso 2 jetfi No 70 | .000000104 | .000000104 |
| Iso 2 jetfi No 7m | .0000000386 | .0000000386 |
| Iso 2 jetfi No ru | .0000000000822 | .0000000000822 |
| Iso 2 late Man 70 | .000000106 | .000000106 |
| Iso 2 late Man ru | .000000000543 | .000000000543 |
| Iso 2 late No 70 | .00000000321 | .00000000321 |
| Iso 2 late No ru | .00000000000914 | .00000000000914 |

Hazard: iso 3

Coordinates:
78068 22855
78081 22856
78081 22845
78068 22853

Consequences:

| | Day | Night |
|---|---|---|
| Iso 3 jetfi Man 22 | .00000114 | .00000114 |
| Iso 3 jetfi Man 70 | .00000204 | .00000204 |
| Iso 3 jetfi Man 7m | .00000045 | .00000045 |
| Iso 3 jetfi No 22 | .0000000116 | .0000000116 |
| Iso 3 jetfi No 70 | .0000000202 | .0000000202 |
| Iso 3 jetfi No 7m | .00000000454 | .00000000454 |
| Iso 3 late Man 70 | .0000000206 | .0000000206 |
| Iso 3 late No 70 | .000000000624 | .000000000624 |

Hazard: iso 4

Coordinates:
78069 22873
78107 22878
78109 22862
78068 22858

Consequences:

| | Day | Night |
|---|---|---|
| Iso 4 jetfi Man 22 | .0000182 | .0000182 |
| Iso 4 jetfi Man 70 | .0000206 | .0000206 |
| Iso 4 jetfi Man 7m | .0000112 | .0000112 |
| Iso 4 jetfi Man ru | .00000000893 | .00000000893 |
| Iso 4 jetfi No 22 | .000000183 | .000000183 |
| Iso 4 jetfi No 70 | .000000208 | .000000208 |
| Iso 4 jetfi No 7m | .000000113 | .000000113 |
| Iso 4 jetfi No ru | .0000000000855 | .0000000000855 |
| Iso 4 late Man 22 | .000000183 | .000000183 |
| Iso 4 late Man 70 | .000000208 | .000000208 |
| Iso 4 late Man ru | .000000000118 | .000000000118 |
| Iso 4 late No 22 | .00000000185 | .00000000185 |
| Iso 4 late No 70 | .0000000021 | .0000000021 |
| Iso 4 late No ru | .00000000000585 | .00000000000585 |

Hazard: iso 5

Coordinates:
78001 22822
78022 22824
78024 22806
78003 22804

Consequences:

| | Day | Night |
|---|---|---|
| Iso 5 jetfi Man 22 | .00000883 | .00000883 |
| Iso 5 jetfi Man 70 | .0000103 | .0000103 |
| Iso 5 jetfi Man 7m | .00000691 | .00000691 |
| Iso 5 jetfi Man ru | .00000000407 | .00000000407 |
| Iso 5 jetfi No 22 | .0000000891 | .0000000891 |
| Iso 5 jetfi No 70 | .0000000959 | .0000000959 |
| Iso 5 jetfi No 7m | .0000000698 | .0000000698 |
| Iso 5 jetfi No ru | .0000000000411 | .0000000000411 |
| Iso 5 late Man 22 | .0000000891 | .0000000891 |
| Iso 5 late Man 70 | .000000211 | .000000211 |
| Iso 5 late Man ru | .000000000452 | .000000000452 |
| Iso 5 late No 22 | .0000000009 | .0000000009 |
| Iso 5 late No 70 | .0000000107 | .0000000107 |
| Iso 5 late No ru | .00000000000457 | .00000000000457 |

Hazard: iso 6

Coordinates:
78032 22846
78050 22848
78053 22825
78035 22823

Consequences:

| | Day | Night |
|---|---|---|
| Iso 6 late Man 22 | .0000000176 | .0000000176 |
| Iso 6 late Man 70 | .0000000355 | .0000000355 |
| Iso 6 late Man ru | .0000000000226 | .0000000000226 |
| Iso 6 late No 22 | .000000000178 | .000000000178 |
| Iso 6 late No 70 | .000000000359 | .000000000359 |
| Iso 6 late No ru | .000000000000228 | .000000000000228 |
| Iso 6 poolf Man 22 | .00000174 | .00000174 |
| Iso 6 poolf Man 70 | .00000351 | .00000351 |
| Iso 6 poolf Man 7m | .000000755 | .000000755 |
| Iso 6 poolf Man ru | .00000000224 | .00000000224 |
| Iso 6 poolf No 22 | .0000000176 | .0000000176 |
| Iso 6 poolf No 70 | .0000000355 | .0000000355 |
| Iso 6 poolf No 7m | .00000000763 | .00000000763 |
| Iso 6 poolf No ru | .0000000000226 | .0000000000226 |

Hazard: iso 7

Coordinates:

| | |
|---|---|
| 78075 | 22788 |
| 78080 | 22789 |
| 78081 | 22784 |
| 78076 | 22783 |

Consequences:

| | Day | Night |
|---|---|---|
| Iso 7 late Man 22 | .0000000134 | .0000000134 |
| Iso 7 late Man 70 | .0000000211 | .0000000211 |
| Iso 7 late Man ru | .0000000000226 | .0000000000226 |
| Iso 7 late No 22 | .000000000136 | .000000000136 |
| Iso 7 late No 70 | .000000000213 | .000000000213 |
| Iso 7 late No ru | .000000000000228 | .000000000000228 |
| Iso 7 poolf Man 22 | .00000133 | .00000133 |
| Iso 7 poolf Man 70 | .00000209 | .00000209 |
| Iso 7 poolf Man 7m | .00000185 | .00000185 |
| Iso 7 poolf Man ru | .00000000224 | .00000000224 |
| Iso 7 poolf No 22 | .0000000134 | .0000000134 |
| Iso 7 poolf No 70 | .0000000211 | .0000000211 |
| Iso 7 poolf No 7m | .0000000187 | .0000000187 |
| Iso 7 poolf No ru | .0000000000226 | .0000000000226 |

Hazard: iso 8

Coordinates:

| | |
|---|---|
| 78080 | 22789 |
| 78093 | 22790 |
| 78094 | 22785 |
| 78081 | 22784 |

Consequences:

| | Day | Night |
|---|---|---|
| Iso 8 late Man 22 | .00000000501 | .00000000501 |
| Iso 8 late Man 70 | .0000000103 | .0000000103 |
| Iso 8 late No 22 | .0000000000506 | .0000000000506 |
| Iso 8 late No 70 | .000000000104 | .000000000104 |
| Iso 8 poolf Man 22 | .000000496 | .000000496 |
| Iso 8 poolf Man 70 | .00000102 | .00000102 |
| Iso 8 poolf Man 7m | .000000216 | .000000216 |
| Iso 8 poolf No 22 | .00000000501 | .00000000501 |
| Iso 8 poolf No 70 | .0000000103 | .0000000103 |
| Iso 8 poolf No 7m | .00000000219 | .00000000219 |

Hazard: iso 9

Coordinates:

| | |
|---|---|
| 78095 | 22795 |
| 78123 | 22799 |
| 78125 | 22786 |
| 78096 | 22783 |

Consequences:

| | Day | Night |
|---|---|---|
| Iso 9 late Man 22 | .000000199 | .000000199 |
| Iso 9 late Man 70 | .000000231 | .000000231 |
| Iso 9 late Man ru | .000000000298 | .000000000298 |
| Iso 9 late No 22 | .00000000201 | .00000000201 |
| Iso 9 late No 70 | .00000000233 | .00000000233 |

| | | |
|---|---|---|
| Iso 9 late No ru | .00000000000301 | .00000000000301 |
| Iso 9 poolf Man 22 | .0000197 | .0000197 |
| Iso 9 poolf Man 70 | .0000229 | .0000229 |
| Iso 9 poolf Man 7m | .0000149 | .0000149 |
| Iso 9 poolf Man ru | .0000000295 | .0000000295 |
| Iso 9 poolf No 22 | .000000199 | .000000199 |
| Iso 9 poolf No 70 | .000000231 | .000000231 |
| Iso 9 poolf No 7m | .000000151 | .000000151 |
| Iso 9 poolf No ru | .000000000298 | .000000000298 |

Hazard: tox i4

Coordinates:

| | |
|---|---|
| 78069 | 22873 |
| 78107 | 22878 |
| 78109 | 22862 |
| 78068 | 22856 |

Consequences:

| | Day | Night |
|---|---|---|
| Tox i4 70mm | .0000004905 | .0000004905 |
| Tox i4 rup | .000000000213 | .000000000213 |

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# APPENDIX H Parts Count

Due to the size of the Part Count record, it is available upon request, if not included with this report.

**CLIENT:** URS

**JOB DESCRIPTION:** GTL Methanol Plant Preliminary Risk Assessment

**EQUIPMENT HOLE SIZE DISTRIBUTION WORKSHEET**

| Location | | |
|---|---|---|
| | | N |
| | | E |

| | | |
|---|---|---|
| Location | ISO1 | |
| Release Stream | | |
| Description | Reforming | |
| Operating Pressure | 2300.0 | kPa |
| Operating Temperature | 40 - 380 | °C |

| | |
|---|---|
| Tank | |
| Pump | |
| Reciprocating Comp. | 1 |
| Centrifugal Comp. | 1 |
| Pressure Vessel | 1 |
| S&T Heat Exchanger | 1 |
| Plate Exchanger | 0.5 |
| Cover | |
| Flexible Hose | |
| Flanges | 46 |
| Valves | 128 |
| Pipes | 208 |
| Press Connection | |
| Misc Press Connection | |
| Level Bridle | |
| Level Gauge | 85 |

| Calculated Release Frequencies | |
|---|---|
| 7 mm | 7.64E-01 |
| 22 mm | 7.46E-02 |
| 70 mm | 2.04E-02 |
| Rupture | 1.31E-06 |
| TOTAL | 8.59E-01 |

**CLIENT:** URS

**JOB DESCRIPTION:** GTL Methanol Plant Preliminary Risk Assessment

| Location | | N |
|---|---|---|
| | | E |

**EQUIPMENT HOLE SIZE DISTRIBUTION WORKSHEET**

| | |
|---|---|
| Location | ISO2 |
| Release Stream | |
| Description | Reforming |
| Operating Pressure | 4000.0 kPa |
| Operating Temperature | 210 - 380 °C |

| Calculated Release Frequencies | |
|---|---|
| 7 mm | 6.71E-02 |
| 22 mm | 1.54E-02 |
| 70 mm | 6.13E-03 |
| Rupture | 5.24E-06 |
| TOTAL | 8.87E-02 |

| | |
|---|---|
| Tank | |
| Pump | |
| Reciprocating Comp. | |
| Centrifugal Comp. | |
| Pressure Vessel | 4 |
| S&T Heat Exchanger | 3.5 |
| Plate Exchanger | |
| Cover | |
| Flexible Hose | |
| Flanges | 17 |
| Valves | 49 |
| Pipes | 81 |
| Press Connection | |
| Misc Press Connection | |
| Level Bridle | |
| Level Gauge | 14 |

**CLIENT:** URS
**JOB DESCRIPTION:** GTL Methanol Plant Preliminary Risk Assessment

| Location | | N |
|---|---|---|
| | | E |

**EQUIPMENT HOLE SIZE DISTRIBUTION WORKSHEET**

| | |
|---|---|
| Location | ISO3 |
| Release Stream | |
| Description | Reforming |
| Operating Pressure | 4000.0 kPa |
| Operating Temperature | 210 °C |

| Calculated Release Frequencies | |
|---|---|
| 7 mm | 7.89E-03 |
| 22 mm | 2.87E-03 |
| 70 mm | 1.19E-03 |
| Rupture | 0.00E+00 |
| TOTAL | 1.20E-02 |

| | |
|---|---|
| Tank | |
| Pump | |
| Reciprocating Comp. | |
| Centrifugal Comp. | |
| Pressure Vessel | |
| S&T Heat Exchanger | |
| Plate Exchanger | |
| Cover | |
| Flexible Hose | |
| Flanges | 2 |
| Valves | 10 |
| Pipes | 14 |
| Press Connection | |
| Misc Press Connection | |
| Level Bridle | |
| Level Gauge | 6 |

**CLIENT:** URS

**JOB DESCRIPTION:** GTL Methanol Plant Preliminary Risk Assessment

| Location | | N |
|---|---|---|
| | | E |

**EQUIPMENT HOLE SIZE DISTRIBUTION WORKSHEET**

| | | |
|---|---|---|
| Location | ISO4 | |
| Release Stream | | |
| Description | Reforming | |
| Operating Pressure | 3000.0 | kPa |
| Operating Temperature | 560 | °C |

| Calculated Release Frequencies | |
|---|---|
| 7 mm | 1.96E-01 |
| 22 mm | 4.55E-02 |
| 70 mm | 1.21E-02 |
| Rupture | 5.24E-06 |
| TOTAL | 2.54E-01 |

| | |
|---|---|
| Tank | |
| Pump | |
| Reciprocating Comp. | |
| Centrifugal Comp. | 1 |
| Pressure Vessel | 4 |
| S&T Heat Exchanger | 11.5 |
| Plate Exchanger | 0.5 |
| Cover | |
| Flexible Hose | |
| Flanges | 45 |
| Valves | 89 |
| Pipes | 149 |
| Press Connection | |
| Misc Press Connection | |
| Level Bridle | |
| Level Gauge | 77 |

**CLIENT:** URS
**JOB DESCRIPTION:** GTL Methanol Plant Preliminary Risk Assessment

| Location | | N |
|---|---|---|
| | | E |

**EQUIPMENT HOLE SIZE DISTRIBUTION WORKSHEET**

| | |
|---|---|
| **Location** | ISO5 |
| **Release Stream** | |
| **Description** | Methanol Synthesis |
| **Operating Pressure** | 8000.0 kPa |
| **Operating Temperature** | 225 °C |

| Calculated Release Frequencies | |
|---|---|
| **7 mm** | **1.21E-01** |
| **22 mm** | **2.21E-02** |
| **70 mm** | **6.11E-03** |
| **Rupture** | **2.62E-06** |
| **TOTAL** | **1.50E-01** |

| | |
|---|---|
| **Tank** | |
| **Pump** | |
| **Reciprocating Comp.** | |
| **Centrifugal Comp.** | 3 |
| **Pressure Vessel** | 2 |
| **S&T Heat Exchanger** | 4 |
| **Plate Exchanger** | |
| **Cover** | |
| **Flexible Hose** | |
| **Flanges** | 15 |
| **Valves** | 47 |
| **Pipes** | 62 |
| **Press Connection** | |
| **Misc Press Connection** | |
| **Level Bridle** | |
| **Level Gauge** | 37 |

**CLIENT:** URS
**JOB DESCRIPTION:** GTL Methanol Plant Preliminary Risk Assessment

**EQUIPMENT HOLE SIZE DISTRIBUTION WORKSHEET**

| | | |
|---|---|---|
| Location | | N |
| | | E |

| | | |
|---|---|---|
| **Location** | ISO6 | |
| **Release Stream** | | |
| **Description** | Methanol Synthesis | |
| **Operating Pressure** | 550.0 | kPa |
| **Operating Temperature** | 40 | °C |

| **Calculated Release Frequencies** | |
|---|---|
| **7 mm** | **1.33E-02** |
| **22 mm** | **4.37E-03** |
| **70 mm** | **2.06E-03** |
| **Rupture** | **1.31E-06** |
| **TOTAL** | **1.97E-02** |

| | |
|---|---|
| **Tank** | |
| **Pump** | |
| **Reciprocating Comp.** | |
| **Centrifugal Comp.** | |
| **Pressure Vessel** | 1 |
| **S&T Heat Exchanger** | |
| **Plate Exchanger** | |
| **Cover** | |
| **Flexible Hose** | |
| **Flanges** | 4 |
| **Valves** | 17 |
| **Pipes** | 23 |
| **Press Connection** | |
| **Misc Press Connection** | |
| **Level Bridle** | |
| **Level Gauge** | 7 |

**CLIENT:** URS
**JOB DESCRIPTION:** GTL Methanol Plant Preliminary Risk Assessment

| Location | | N |
|---|---|---|
| | | E |

**EQUIPMENT HOLE SIZE DISTRIBUTION WORKSHEET**

| | | |
|---|---|---|
| **Location** | ISO7 | |
| **Release Stream** | | |
| **Description** | Methanol Distillation | |
| **Operating Pressure** | 3.0 | kPa |
| **Operating Temperature** | 38 - 92 | °C |

| Calculated Release Frequencies | |
|---|---|
| **7 mm** | **3.25E-02** |
| **22 mm** | **3.33E-03** |
| **70 mm** | **1.22E-03** |
| **Rupture** | **1.31E-06** |
| **TOTAL** | **3.71E-02** |

| | |
|---|---|
| **Tank** | |
| **Pump** | 1 |
| **Reciprocating Comp.** | |
| **Centrifugal Comp.** | |
| **Pressure Vessel** | 1 |
| **S&T Heat Exchanger** | |
| **Plate Exchanger** | |
| **Cover** | |
| **Flexible Hose** | |
| **Flanges** | 6 |
| **Valves** | 8 |
| **Pipes** | 15 |
| **Press Connection** | |
| **Misc Press Connection** | |
| **Level Bridle** | |
| **Level Gauge** | 1 |

| | | | | |
|---|---|---|---|---|
| **CLIENT:** | **URS** | | | |
| **JOB DESCRIPTION:** | **GTL Methanol Plant Preliminary Risk Assessment** | | | |
| | | | **Location** | N |
| **EQUIPMENT HOLE SIZE DISTRIBUTION WORKSHEET** | | | | E |

| | | | | |
|---|---|---|---|---|
| **Location** | ISO8 | | **Tank** | |
| **Release Stream** | | | **Pump** | |
| **Description** | Methanol Distillation | | **Reciprocating Comp.** | |
| | | | **Centrifugal Comp.** | |
| **Operating Pressure** | 860.0 | kPa | **Pressure Vessel** | |
| **Operating Temperature** | 92 | °C | **S&T Heat Exchanger** | |
| | | | **Plate Exchanger** | |
| | | | **Cover** | |
| | | | **Flexible Hose** | |
| | | | **Flanges** | 1 |
| | | | **Valves** | 5 |
| **Calculated Release Frequencies** | | | **Pipes** | 6 |
| **7 mm** | **3.80E-03** | | **Press Connection** | |
| **22 mm** | **1.24E-03** | | **Misc Press Connection** | |
| **70 mm** | **5.95E-04** | | **Level Bridle** | |
| **Rupture** | **0.00E+00** | | **Level Gauge** | 2 |
| **TOTAL** | **5.64E-03** | | | |

**CLIENT:** URS
**JOB DESCRIPTION:** GTL Methanol Plant Preliminary Risk Assessment

| Location | | N |
|---|---|---|
| | | E |

**EQUIPMENT HOLE SIZE DISTRIBUTION WORKSHEET**

| | |
|---|---|
| **Location** | ISO9 |
| **Release Stream** | |
| **Description** | Methanol Distillation |
| **Operating Pressure** | 6.0 kPa |
| **Operating Temperature** | 40 - 137 °C |

| **Calculated Release Frequencies** | |
|---|---|
| **7 mm** | **2.62E-01** |
| **22 mm** | **4.95E-02** |
| **70 mm** | **1.34E-02** |
| **Rupture** | **1.12E-05** |
| **TOTAL** | **3.25E-01** |

| | |
|---|---|
| **Tank** | 1 |
| **Pump** | 4 |
| **Reciprocating Comp.** | |
| **Centrifugal Comp.** | |
| **Pressure Vessel** | 4 |
| **S&T Heat Exchanger** | 8 |
| **Plate Exchanger** | |
| **Cover** | |
| **Flexible Hose** | |
| **Flanges** | 82 |
| **Valves** | 90 |
| **Pipes** | 173 |
| **Press Connection** | |
| **Misc Press Connection** | |
| **Level Bridle** | |
| **Level Gauge** | 77 |

**CLIENT:** URS

**JOB DESCRIPTION:** GTL Methanol Plant Preliminary Risk Assessment

| Location | | N |
|---|---|---|
| | | E |

**EQUIPMENT HOLE SIZE DISTRIBUTION WORKSHEET**

| | | |
|---|---|---|
| Location | ISO10 | |
| Release Stream | | |
| Description | Methanol tanks | |
| Operating Pressure | 300.0 | kPa |
| Operating Temperature | 40 | °C |

| Calculated Release Frequencies | |
|---|---|
| 7 mm | 3.07E-02 |
| 22 mm | 3.01E-03 |
| 70 mm | 8.76E-04 |
| Rupture | 6.00E-06 |
| TOTAL | 3.46E-02 |

| | |
|---|---|
| Tank | 1 |
| Pump | 1 |
| Reciprocating Comp. | |
| Centrifugal Comp. | |
| Pressure Vessel | |
| S&T Heat Exchanger | |
| Plate Exchanger | |
| Cover | |
| Flexible Hose | |
| Flanges | 6 |
| Valves | 5 |
| Pipes | 10 |
| Press Connection | |
| Misc Press Connection | |
| Level Bridle | |
| Level Gauge | 2 |

**CLIENT:** URS

**JOB DESCRIPTION:** GTL Methanol Plant Preliminary Risk Assessment

| Location | | N |
|---|---|---|
| | | E |

**EQUIPMENT HOLE SIZE DISTRIBUTION WORKSHEET**

| | |
|---|---|
| Location | ISO11 |
| Release Stream | |
| Description | Methanol tanks |
| Operating Pressure | 300.0 kPa |
| Operating Temperature | 40 °C |

| Calculated Release Frequencies | |
|---|---|
| 7 mm | 3.41E-02 |
| 22 mm | 1.16E-02 |
| 70 mm | 5.01E-03 |
| Rupture | 0.00E+00 |
| TOTAL | 5.08E-02 |

| | |
|---|---|
| Tank | |
| Pump | |
| Reciprocating Comp. | |
| Centrifugal Comp. | |
| Pressure Vessel | |
| S&T Heat Exchanger | |
| Plate Exchanger | |
| Cover | |
| Flexible Hose | |
| Flanges | 16 |
| Valves | 40 |
| Pipes | 38 |
| Press Connection | |
| Misc Press Connection | |
| Level Bridle | |
| Level Gauge | 21 |

| | | | | |
|---|---|---|---|---|
| **CLIENT:** | **URS** | | | |
| **JOB DESCRIPTION:** | **GTL Methanol Plant Preliminary Risk Assessment** | | | |
| | | | **Location** | N |
| **EQUIPMENT HOLE SIZE DISTRIBUTION WORKSHEET** | | | | E |

| | | |
|---|---|---|
| **Location** | ISO12 | |
| **Release Stream** | | |
| **Description** | Methanol tanks | |
| **Operating Pressure** | 300.0 | kPa |
| **Operating Temperature** | 40 | °C |

| **Calculated Release Frequencies** | |
|---|---|
| **7 mm** | **3.70E-02** |
| **22 mm** | **5.34E-03** |
| **70 mm** | **1.89E-03** |
| **Rupture** | **6.00E-06** |
| **TOTAL** | **4.43E-02** |

| | |
|---|---|
| **Tank** | 1 |
| **Pump** | 1 |
| **Reciprocating Comp.** | |
| **Centrifugal Comp.** | |
| **Pressure Vessel** | |
| **S&T Heat Exchanger** | |
| **Plate Exchanger** | |
| **Cover** | |
| **Flexible Hose** | |
| **Flanges** | 6 |
| **Valves** | 14 |
| **Pipes** | 20 |
| **Press Connection** | |
| **Misc Press Connection** | |
| **Level Bridle** | |
| **Level Gauge** | 7 |

**CLIENT:** URS

**JOB DESCRIPTION:** GTL Methanol Plant Preliminary Risk Assessment

| Location | | N |
|---|---|---|
| | | E |

**EQUIPMENT HOLE SIZE DISTRIBUTION WORKSHEET**

| | |
|---|---|
| Location | ISO13 |
| Release Stream | |
| Description | Methanol tanks |
| Operating Pressure | 300.0 kPa |
| Operating Temperature | 40 °C |

| | |
|---|---|
| Tank | |
| Pump | |
| Reciprocating Comp. | |
| Centrifugal Comp. | |
| Pressure Vessel | |
| S&T Heat Exchanger | |
| Plate Exchanger | |
| Cover | |
| Flexible Hose | |
| Flanges | 15 |
| Valves | 21 |
| Pipes | 34 |
| Press Connection | |
| Misc Press Connection | |
| Level Bridle | |
| Level Gauge | 12 |

| Calculated Release Frequencies | |
|---|---|
| 7 mm | 2.08E-02 |
| 22 mm | 6.98E-03 |
| 70 mm | 2.86E-03 |
| Rupture | 0.00E+00 |
| TOTAL | 3.07E-02 |

**CLIENT:** URS

**JOB DESCRIPTION:** GTL Methanol Plant Preliminary Risk Assessment

| Location | | N |
|---|---|---|
| | | E |

**EQUIPMENT HOLE SIZE DISTRIBUTION WORKSHEET**

| | | |
|---|---|---|
| **Location** | ISO14 | |
| **Release Stream** | | |
| **Description** | Methanol tanks | |
| **Operating Pressure** | 101.3 | kPa |
| **Operating Temperature** | 25 | °C |

| Calculated Release Frequencies | |
|---|---|
| **7 mm** | **3.01E-02** |
| **22 mm** | **2.87E-03** |
| **70 mm** | **7.67E-04** |
| **Rupture** | **6.00E-06** |
| **TOTAL** | **3.38E-02** |

| | |
|---|---|
| **Tank** | 1 |
| **Pump** | 1 |
| **Reciprocating Comp.** | |
| **Centrifugal Comp.** | |
| **Pressure Vessel** | |
| **S&T Heat Exchanger** | |
| **Plate Exchanger** | |
| **Cover** | |
| **Flexible Hose** | |
| **Flanges** | 6 |
| **Valves** | 4 |
| **Pipes** | 12 |
| **Press Connection** | |
| **Misc Press Connection** | |
| **Level Bridle** | |
| **Level Gauge** | 2 |

**CLIENT:** URS

**JOB DESCRIPTION:** GTL Methanol Plant Preliminary Risk Assessment

**EQUIPMENT HOLE SIZE DISTRIBUTION WORKSHEET**

| | | |
|---|---|---|
| Location | | N |
| | | E |

| | | |
|---|---|---|
| Location | ISO15 | |
| Release Stream | | |
| Description | Methanol tanks | |
| Operating Pressure | 101.3 | kPa |
| Operating Temperature | 25 | °C |

| Calculated Release Frequencies | |
|---|---|
| 7 mm | 3.11E-03 |
| 22 mm | 7.66E-04 |
| 70 mm | 4.40E-04 |
| Rupture | 0.00E+00 |
| TOTAL | 4.31E-03 |

| | |
|---|---|
| Tank | |
| Pump | |
| Reciprocating Comp. | |
| Centrifugal Comp. | |
| Pressure Vessel | |
| S&T Heat Exchanger | |
| Plate Exchanger | |
| Cover | |
| Flexible Hose | |
| Flanges | 3 |
| Valves | 3 |
| Pipes | 7 |
| Press Connection | |
| Misc Press Connection | |
| Level Bridle | |
| Level Gauge | |

**CLIENT:** URS

**JOB DESCRIPTION:** GTL Methanol Plant Preliminary Risk Assessment

| Location | | N |
|---|---|---|
| | | E |

**EQUIPMENT HOLE SIZE DISTRIBUTION WORKSHEET**

| | | |
|---|---|---|
| Location | ISO16 | |
| Release Stream | | |
| Description | Loading System | |
| Operating Pressure | 300.0 | kPa |
| Operating Temperature | 25 | °C |

| Calculated Release Frequencies | |
|---|---|
| 7 mm | 5.31E-03 |
| 22 mm | 1.31E-03 |
| 70 mm | 8.02E-04 |
| Rupture | 0.00E+00 |
| TOTAL | 7.42E-03 |

| | |
|---|---|
| Tank | |
| Pump | |
| Reciprocating Comp. | |
| Centrifugal Comp. | |
| Pressure Vessel | |
| S&T Heat Exchanger | |
| Plate Exchanger | |
| Cover | |
| Flexible Hose | |
| Flanges | 4 |
| Valves | 6 |
| Pipes | 4 |
| Press Connection | |
| Misc Press Connection | |
| Level Bridle | |
| Level Gauge | |

**CLIENT:** URS
**JOB DESCRIPTION:** GTL Methanol Plant Preliminary Risk Assessment

| Location | | N |
|---|---|---|
| | | E |

**EQUIPMENT HOLE SIZE DISTRIBUTION WORKSHEET**

| | |
|---|---|
| Location | ISO17 |
| Release Stream | |
| Description | Slops tanks |
| Operating Pressure | 101.3 kPa |
| Operating Temperature | 25 °C |

| Calculated Release Frequencies | |
|---|---|
| 7 mm | 5.40E-02 |
| 22 mm | 3.56E-03 |
| 70 mm | 8.11E-04 |
| Rupture | 6.00E-06 |
| TOTAL | 5.83E-02 |

| | |
|---|---|
| Tank | 1 |
| Pump | 2 |
| Reciprocating Comp. | |
| Centrifugal Comp. | |
| Pressure Vessel | |
| S&T Heat Exchanger | |
| Plate Exchanger | |
| Cover | |
| Flexible Hose | |
| Flanges | 4 |
| Valves | 4 |
| Pipes | 10 |
| Press Connection | |
| Misc Press Connection | |
| Level Bridle | |
| Level Gauge | |

**CLIENT:** URS
**JOB DESCRIPTION:** GTL Methanol Plant Preliminary Risk Assessment

| Location | | N |
|---|---|---|
| | | E |

**EQUIPMENT HOLE SIZE DISTRIBUTION WORKSHEET**

| | |
|---|---|
| **Location** | ISO18 |
| **Release Stream** | |
| **Description** | Export Pipeline |
| **Operating Pressure** | 101.3 kPa |
| **Operating Temperature** | 25 °C |

| Calculated Release Frequencies | |
|---|---|
| **7 mm** | **6.01E-02** |
| **22 mm** | **5.50E-03** |
| **70 mm** | **2.74E-03** |
| **Rupture** | **3.80E-04** |
| **TOTAL** | **6.87E-02** |

| | |
|---|---|
| **Tank** | |
| **Pump** | 2 |
| **Reciprocating Comp.** | |
| **Centrifugal Comp.** | |
| **Pressure Vessel** | |
| **S&T Heat Exchanger** | |
| **Plate Exchanger** | |
| **Cover** | |
| **Flexible Hose** | |
| **Flanges** | 6 |
| **Valves** | 12 |
| **Pipes** | 1 |
| **Press Connection** | |
| **Misc Press Connection** | |
| **Level Bridle** | |
| **Level Gauge** | |

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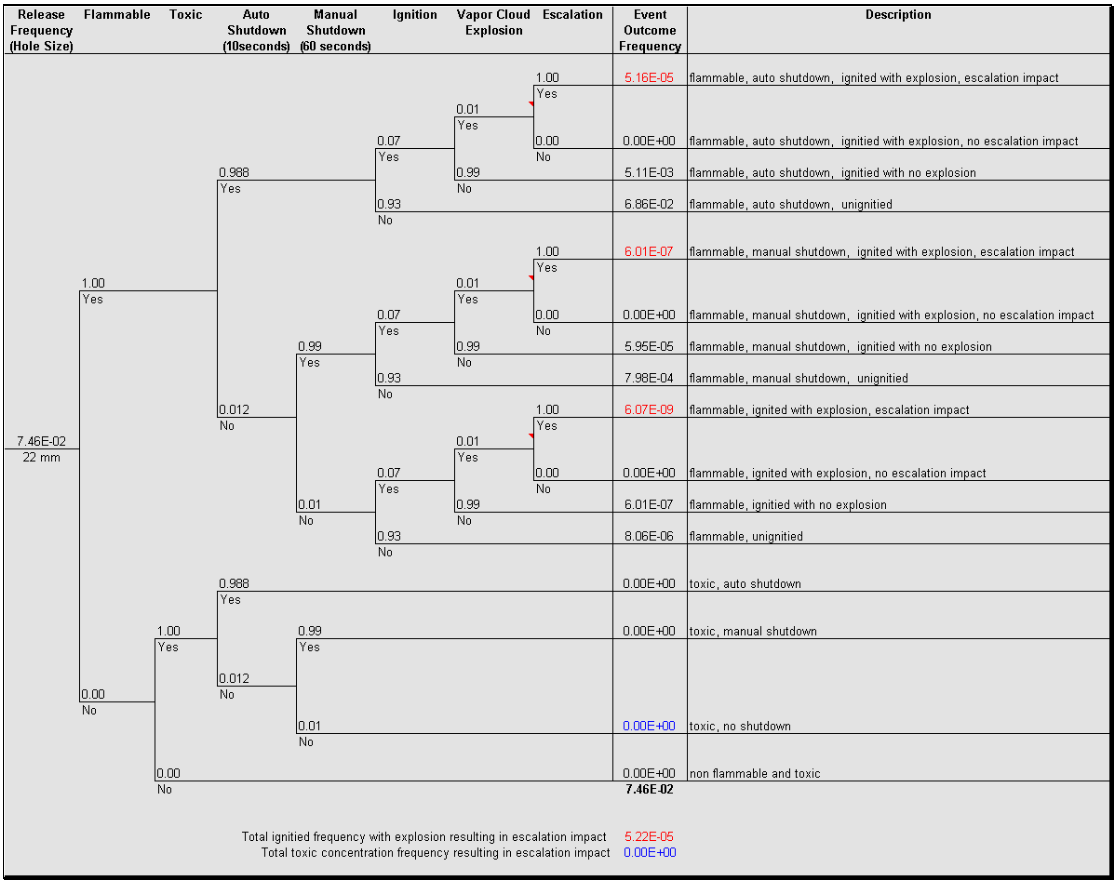
# APPENDIX I  Sample Event Tree

The sample event tree is for a 22 mm leak within the first isolatable section within Unit 100.



# APPENDIX J Consequence Modelling Using PHAST

Details of Calculations
The calculations can be divided into four stages:

- Discharge,
- Immediate Fire and Explosion,
- Cloud Dispersion,
- Delayed Fire, Explosion, and
- Toxic Effects

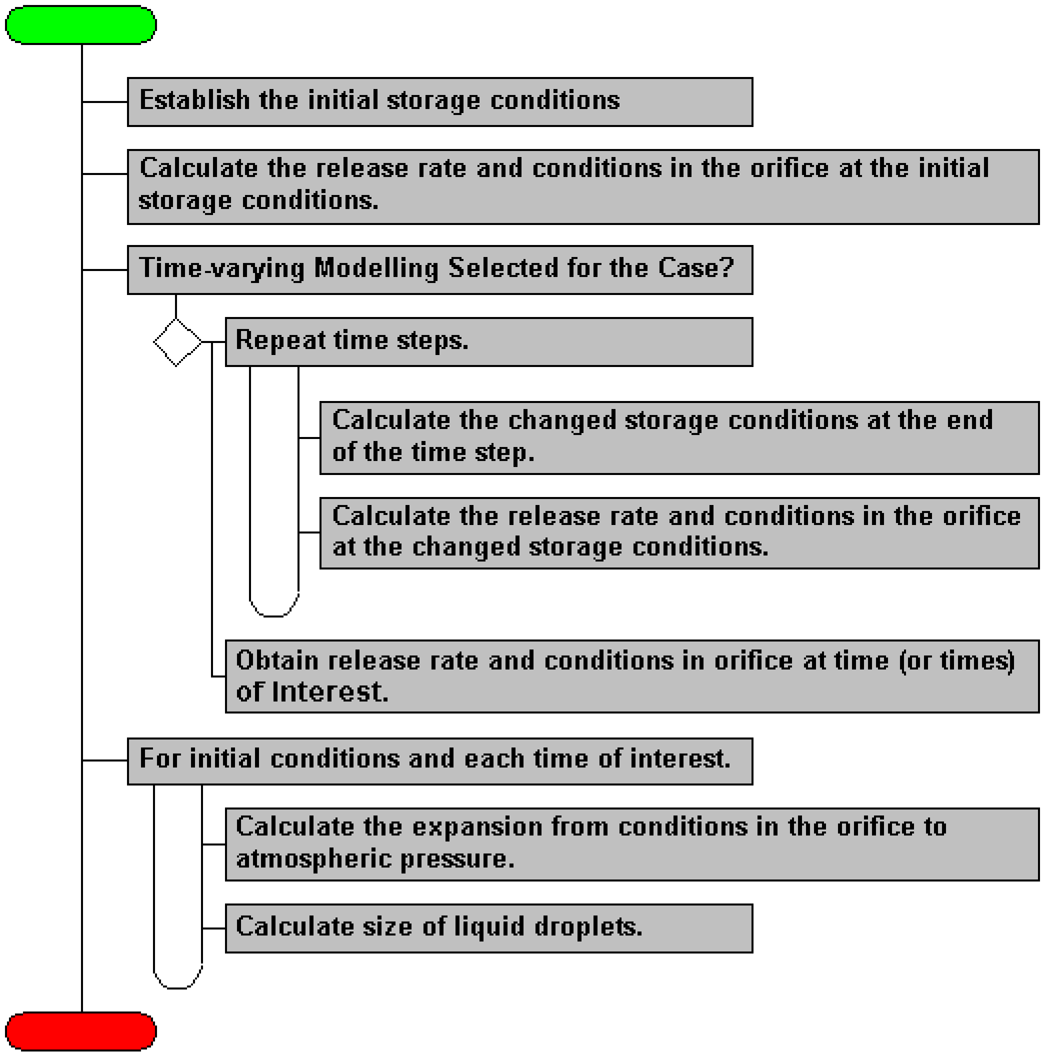
**Discharge Conditions**
You define the Case by describing the storage conditions, and the type and size of release (e.g. hole size), and the program determines the state of the material after it has been released from confinement, and has expanded down to atmospheric pressure.

**Discharge Calculations**
For all Cases, the program predicts the condition of the material once it has been discharged and has expanded down to atmospheric pressure. There are two main types of discharge calculation:

- Continuous Release, and
- Instantaneous Release

*Continuous Release*
This describes the discharge calculations for all scenarios except Catastrophic Ruptures (see: Setting the Scenario for a Case).

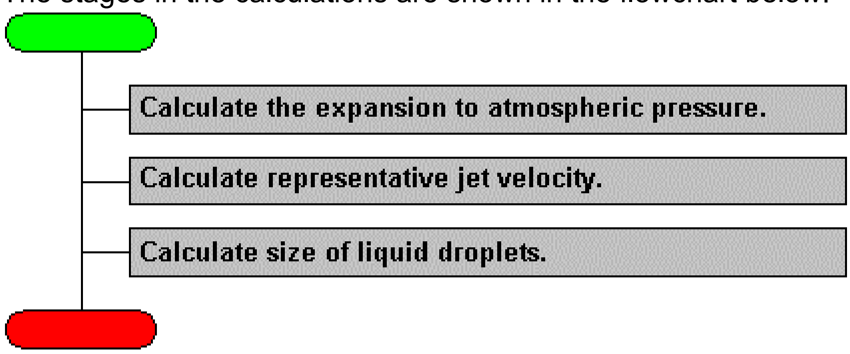
The stages in the calculations are shown in the flowchart below.




*Instantaneous Release*

The instantaneous modeling is used if the Case is set as a Catastrophic Rupture in the Scenario tab section.

The stages in the calculations are shown in the flowchart below.




Immediate Flammable Effects

If the material is flammable, then the material may ignite immediately upon release, giving either a fire or an explosion which is centered around the release location. The program calculates the size and intensity of the effects, and the details of the calculations depend on the type of release, and the state of the material immediately after discharge:

| Type of Release | State after Discharge | Effect modeled |
|---|---|---|
| **Instantaneous** | All | BLEVE or Fireball |
| **Instantaneous** | Contains vapor | Explosion |
| **Continuous** | Contains vapor, has high momentum | Jet Fire |
| **Both** | Contains liquid | Pool Fire |

For some types of release, more than one effect will be modeled. For instance, a two-phase instantaneous release can produce a pool fire, a BLEVE, and an explosion, and the program will perform calculations for all three effects.

See further details for:
- Pool Fire
- Jet Fire
- BLEVE
- Explosion

Cloud Dispersion
The program next models the scenario in which the release does not ignite immediately, but forms a cloud which moves away from the release location, entraining air until it is eventually diluted to a harmless concentration.

The hazard posed by the cloud depends on its size, location and concentration-profile. These all change with time, and the program must calculate and record these changes in order to describe the cloud and its hazards properly. The calculations are performed by the Unified Dispersion Model (or UDM), which produces a table giving the essential cloud data at various time steps from the start of the release. This table is then used by the various models which calculate the longer-term flammable and toxic effects, described below.

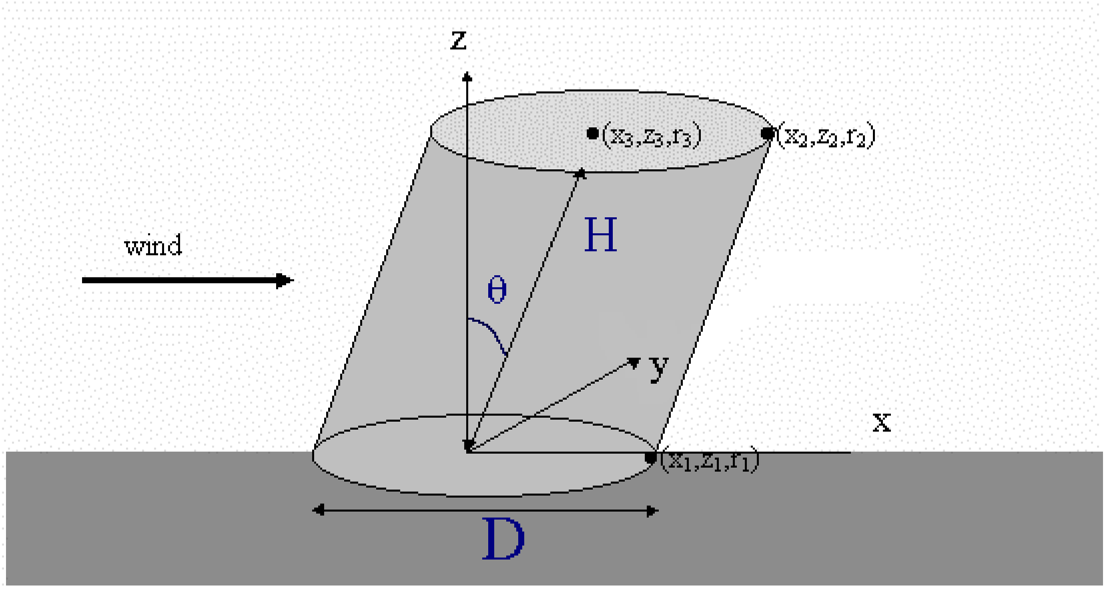
Delayed Hazardous Effects
The delayed hazardous effects are those that occur after the cloud has started to develop.

- Late Pool Fire
- Explosion
- Toxic Effects
- Flash Fire  A flash fire is a low-intensity fire whose effect zone is given by the flammable region of the cloud, and the program simply calculates the dimensions and location of this region at the time of ignition.

**Pool Fire Modeling**

There are three main parts of the calculations:
- Flame Shape,
- Flame Emissive Power, and
- Radiation.

*Calculating the Flame Shape*
The flame is modeled as a cylinder sheared in the direction of the wind, with diameter *D*, height *H* and tilt angle *q* (measured from the vertical), as shown in the illustration. The flame is described by three circles ($c_1$, $c_2$, $c_3$) arranged along the centerline of the flame, each defined by the downwind coordinate *x* and elevation *z* of the center of the circle, and by the radius *r*. These flame-circle coordinates are the main input to the radiation calculations.




*Diameter*

- Instantaneous Release

If the release is bunded, the diameter is given by the size of the bund. If there is no bund, then the diameter is that which corresponds with a minimum pool thickness, set by the type of surface on which the pool is spreading.

- Continuous Release: Early Pool Fire

An early pool fire is one that occurs immediately after rainout, before the cloud has started to disperse away from the pool.

As the first stage in calculating the diameter, the program calculates the pool fire burn rate. This is a function of the properties of the released material, and of the surface on which the pool is burning.

If there is a value set for the maximum burn rate in the properties data, the program will use this value. Otherwise, the maximum burn rate, $m_{max}$, is taken from Burgess and Hertzberg (1974) as:

$$m_{\max} = 10^{-3} \frac{\Delta H_c}{\Delta H_v^*}$$

where $m_{max}$ is in kg/s/m2, and

$$\Delta H_v^* = \Delta H_v + C_{pL}(T_b - T_a) \qquad T_b > T_a$$
$$\Delta H_v^* = \Delta H_v \qquad T_a > T_b$$

where $\Delta H_c$ is the heat of combustion, $\Delta H_v$* is the modified heat of vaporization, $\Delta H_v$ is the heat of vaporization, $C_{pL}$ is the liquid specific heat (a function of the material's boiling point), $T_b$ is the boiling point temperature and $T_a$ is the atmospheric temperature.

If the spill occurs on water, the maximum burn rate is then adjusted by multiplying it by a value of 2.5 (Cook et al., 1990). This accounts for the considerable heat transfer which occurs between a large body of water and the pool of liquefied gas due mainly to the fact that the boiling point is lower than the ambient temperature.

The actual pool fire burn rate is then given by:

$$m = m_{max}\left[1 - e^{-\frac{D}{L_b}}\right]$$

where $m_{max}$ is the maximum burn rate, $D$ is the flame diameter and $L_b$ is the burn rate characteristic scale length, which is taken from the materials property data.

The program calculates the diameter which gives a burning rate that equals the continuous release rate, and then sets the diameter of the pool fire to be the minimum of this diameter and the diameter of the bund (if any).

- Continuous Release: Late Pool Fire

A late pool fire is one that occurs after the cloud has started dispersing away from the pool.

The diameter used for the pool fire calculations is the maximum diameter achieved by the pool during the process of spreading and evaporation.

*Length*

The flame length is given by the Thomas correlation (Mudan, 1984, equation 12) as:

$$H = 42D\left[\frac{m}{\rho_a\sqrt{gD}}\right]^{0.61}$$

where $D$ is the flame diameter, $m$ is the pool fire burn rate, $\rho_a$ is the density of air and $g$ is the acceleration due to gravity.

*Tilt Angle*

The tilt angle, $\theta$, can be approximated by the following equation (Johnson, 1992, equation 4):

$$\frac{\tan\theta}{\cos\theta} = 0.7 Re^{0.109} Fr^{0.428}$$

where Re is a Reynolds number given by:

$$Re = \frac{U_w D}{\nu_a}$$

and Fr is a Froude number given by:

$$Fr = \frac{U_w^2}{gD}$$

where $U_w$ is the wind velocity, $D$ is the flame diameter, $\nu_a$ is the kinematic viscosity of air and $g$ is the acceleration due to gravity.

Multiplying the equation for $\theta$ by $1 - \sin^2\theta$ (which is equal to $\cos^2\theta$) and re-arranging, gives the below quadratic in $\sin\theta$:

$$A \sin^2 \theta + \sin\theta - A = 0$$

where:

$$A = 0.7 Re^{0.109} Fr^{0.428}$$

The standard quadratic formula is used to solve this equation for θ, taking only the positive root.

$$\theta = \arcsin\left(\frac{-1 + \sqrt{1 + 4A^2}}{2A}\right)$$

*Flame Shape Circles*
The pool fire is defined by three circles, where the third circle, $c_3$, has zero radius, and is added in order to complete the top surface of the flame, since the radiation calculations treat the flame as a set of conical surfaces, where each conical surface is bounded by two circles.

With the three circles shown in the illustration above, the radiation calculations will model radiation from two surfaces: from the side of the flame between $c_1$ and $c_2$, and from the top of the flame between $c_2$ and $c_3$. This approach ensures that the bottom of the pool fire is not treated as a radiating surface.

The flame length $H$, flame diameter $D$ and tilt angle $\theta$ are used to calculate three co-ordinates of the flame, as follows:

$$\begin{array}{lll} x_1 = 0.0 & x_2 = H \sin\theta & x_3 = H \sin\theta \\ z_1 = d_{elev} & z_2 = H\cos\theta + d_{elev} & z_3 = H\cos\theta + d_{elev} \\ r_1 = D/2 & r_2 = D/2 & r_3 = 0.0 \\ \phi_1 = 0.0 & \phi_2 = 0.0 & \phi_3 = 0.0 \end{array}$$

$\phi$ is the inclination of the circle with respect to the horizontal. For pool fires, this is set to zero for all three circles, but for jet flames each circle may have a different, non-zero inclination.

*Calculating the Emissive Power*
The emissive power or emissivity $E_f$ can be calculated for both luminous and smoky flames; the type of flame is defined in the property data for each material.

*Luminous flames*
For luminous flames the emissivity is given by:

$$E_f = E_m \left[ 1 - e^{-\frac{D}{L_s}} \right]$$

where $E_m$ is the maximum surface emissive power, $D$ is the flame diameter and $L_s$ is the emissive power characteristic scale length. The emissivity, $E_f$, is then multiplied by 1000.0 to convert from kW/m2 to W/m2.

*Smoky flames*
For smoky flames the emissivity is given by:

$$E_f = E_m \left[ e^{-\frac{D}{L_s}} \right] + E_s \left[ 1 - e^{-\frac{D}{L_s}} \right]$$

where $E_m$ is the maximum surface emissive power, $D$ is the flame diameter and $L_s$ is the emissive power characteristic scale length. $E_s$ is the smoke surface emissive power and is hardwired in the code as 20.0 kW/m2. The emissivity, $E_f$, is then multiplied by 1000.0 to convert from kW/m2 to W/m2.

*Radiation Ellipse Calculations*
These are covered for all fire events later.

**API Jet Fire Modeling**
There are five main parts of the calculations:

- Mass in Jet
- Jet Velocity
- Flame Shape
- Flame Emissive Power
- Radiation

*Mass Involved in Jet*
In calculating the mass, the program uses an average release rate, which is the average over the time set for the Duration for Jet Fire Averaging in the Parameters.

The fraction $f_{flam}$ of this average release rate involved in the jet fire is calculated as follows:

$$f_{flam} = \min\left\{1, R_{fire}\left(1 - f_{rainout}\right)\right\}$$

where $R_{fire}$ is the Jet fire Correction Factor, set in the Jet Fire tab section for the Model, and $f_{rainout}$ is the rainout fraction calculated in the discharge modelling.

*Calculating the Jet Velocity*
The program calculates either the jet velocity or the expanded radius, depending on which items are supplied in the input data:

- Jet Velocity

The jet velocity, $U_0$, is calculated as:

$$U_0 = \frac{Q}{\rho_{vapour} \pi R_{exp}^2}$$

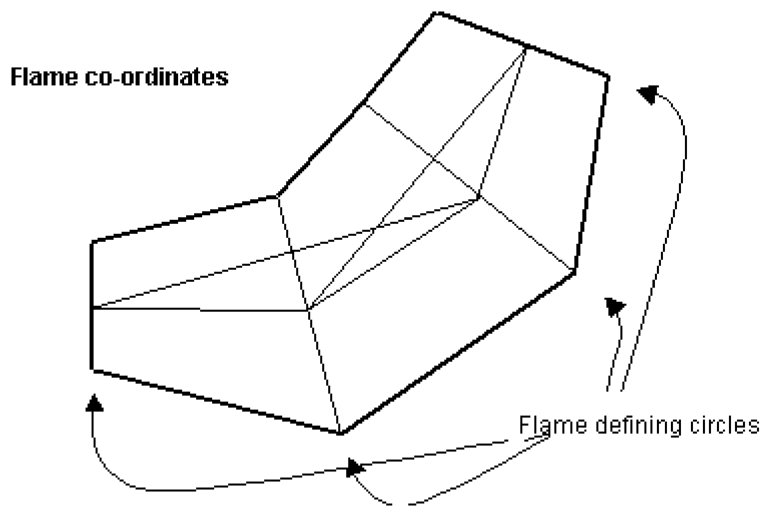
where $Q$ is the mass discharge rate, $\rho_{vapor}$ is the vapor density at one atmosphere (calculated using the Properties Library) and $R_{exp}$ is the expanded radius.

- Expanded Radius

The expanded radius is calculated as:

$$R_{exp} = \left( \frac{Q}{\rho_{vapour} \pi U_0} \right)^{1/2}$$

*Calculating the Flame Shape*
The flame is a jet that may be bent by the wind or by the effects of gravity, and it is described by ten circles ($c_1$ to $c_{10}$) equally spaced along the flame length. Each circle is defined by the downwind coordinate $x$ and elevation $z$ of the center of the circle, by the radius $r$, and by the inclination of the circle from the horizontal $\phi$; the illustration below shows a portion of the middle of a flame, with four circles:




- Flame Length

The flame length, $L$, is calculated as:

$$L = 0.003271918 \times \left(Q\Delta H_{\text{Comb}}\right)^{0.478}$$

where $Q$ is the mass discharge rate and $\Delta H_{comb}$ is the heat of combustion (obtained from the Properties Library).

- Maximum Flame Radius

The maximum radius of the flame is given by:

$$R_{\max} = \frac{0.1244L}{2}$$

where $L$ is the flame length.

- Radii of Flame Circles

The radius of the flame as a function of distance along the length is set according to Baron (1954).

The radius of the first circle, $r_1$, is set equal to the expanded radius of the jet.

For the other circles, the radius, $r_i$, is given by:

$$r_i = \frac{0.29 s_i}{2}\sqrt{\ln\left(\frac{L}{s_i}\right)}$$

where:

$$s_i = \frac{(i-1)}{(N-1)}L$$

and $L$ is the flame length.

- Deflection of a Vertical Flame by the Wind

If the flame is horizontal, then it is assumed not to be deflected by the wind. For a vertical flame, the program first calculates the velocity ratio, $U_{ratio}$, as a measure of the power of the wind to deflect the jet:

$$U_{\text{ratio}} = \frac{U_w}{U_0}$$

where $U_w$ is the wind speed and $U_0$ is the jet velocity.

If the velocity ratio is less than 0.0001, then the flame is treated as being perfectly vertical. For larger values of the velocity ratio, the program calculates the increase in $x$ and $z$ between each circle. For each circle, the gradient $dz/dx$ is given by Cook et al. (1990) as:

$$\frac{dz}{dx} = 3.2\pi \frac{R_{\text{exp}}}{U_{\text{ratio}}}\left(\frac{1}{s} - \frac{1}{L}\right)$$

where $R_{exp}$ is the expanded radius, $U_{ratio}$ is the velocity ratio, $s$ is the distance of the circle along the centerline of the flame, and $L$ is the flame length.

- Coordinates of Flame Circles

The circles are equally spaced along the length of the flame, and the length of each segment, $L_{segment}$, is given by $L/N_{segment}$.

Horizontal Flame

The $z$ coordinate of the center of each circle is set to zero and the $x$ co-ordinate is given by the segment number multiplied by $L_{segment}$.

Unbent Vertical Flame

The $x$ co-ordinate of the center of each circle is set to zero and the $z$ co-ordinate is given by the segment number multiplied by $L_{segment}$.

Bent Vertical Flame

The initial $x$ and $z$ co-ordinates, $x_1$ and $z_1$ are given by:

$$x_1 = 0.0 \qquad z_1 = d_{\text{elevation}}$$

and the subsequent $x$ and $z$ co-ordinates are given by:

$$x_i = x_i + x_{\text{increment}} \qquad z_i = z_i + z_{\text{increment}}$$

where $i$ is the number of the circle, from 2 to $N$, and where $x_{increment}$ and $z_{increment}$ are given by:

$$x_{\text{increment}} = \frac{L_{\text{segment}}}{\sqrt{1+\left(\frac{dz}{dx}\right)^{2}}} \qquad z_{\text{increment}} = \frac{L_{\text{segment}}}{\sqrt{1+\left(\frac{dz}{dx}\right)^{-2}}}$$

- Radii of Flame Circles

The radius of the flame as a function of distance along the length is set according to Baron (1954).

The radius of the first circle, $r_1$, is set equal to the expanded radius of the jet.

For the other circles, the radius, $r_i$, is given by:

$$r_i = \frac{0.29 s_i}{2}\sqrt{\ln\left(\frac{L}{s_i}\right)}$$

where:

$$s_i = \frac{(i-1)}{(N-1)} L$$

and $L$ is the flame length.

- Inclination of Flame Circles to Horizontal

The orientation of each circle is set to be perpendicular to the line joining together the circles lying either side of it:

$$\phi_i = \tan^{-1}\left(\frac{x_{i+1} - x_{i-1}}{z_{i+1} - z_{i-1}}\right)$$

Since this method cannot be used for the the first circle, it is set to be perpendicular to the line from its center to the center of the second circle, i.e.

$$\phi_1 = \tan^{-1}\left(\frac{x_2 - x_1}{z_2 - z_1}\right)$$

Similarly, the last segment is set to be perpendicular to the line from its center to the penultimate circle, i.e:

$$\phi_N = \tan^{-1}\left(\frac{x_N - x_{N-1}}{z_N - z_{N-1}}\right)$$

*Calculating the Emissive Power*

If the emissive power was not specified in the input data, the program calculates it as described below. The calculations involve several stages.

- Fraction of Heat Emitted from Surface of Flame

The fraction, $F_s$, is given by Cook et al. (1990) as:

$$F_s = \{0.21\exp(-0.00323U_0) + 0.11\} f_{MW}$$

where:

$$f_{MW} = \begin{cases} 1 & M_W < 21 \\ \sqrt{\dfrac{M_w}{21}} & 21 \le M_W \le 60 \\ 1.69 & 60 < M_W \end{cases}$$

$U_0$ is the jet velocity and $M_W$ is the molecular weight of the substance released.

If the value calculated is greater than the maximum allowed (set as 0.5), then $F_s$ is set to 0.5.

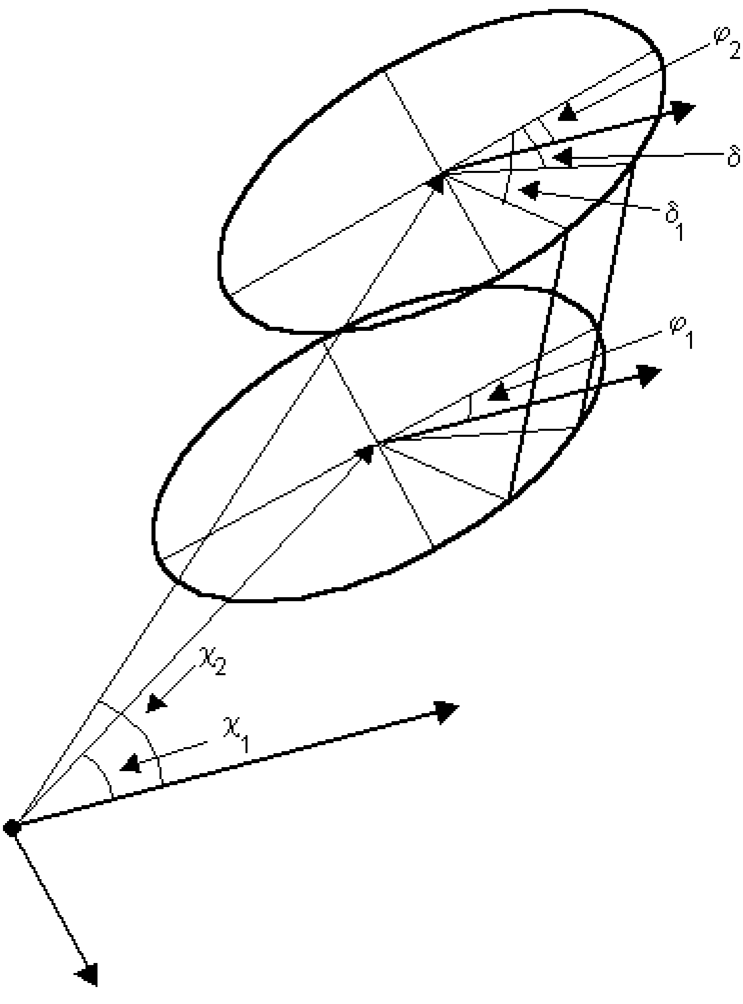
- Surface Area of the Flame

The equation for the emissive power includes the surface area of the flame, which is calculated by considering each segment (or frustum) in turn, dividing it into sectors, and calculating the area for each sector.

There are three main stages in the calculations for each sector:

1: Defining Coordinates
2: Height and Width
3: Surface Area

1: The Defining Coordinates for the Sector
Each sector is described by ten co-ordinates:




Location of Lower and Upper Circles (4 coordinates)

These are given in polar co-ordinates in the x-z plane, and are stored as $\delta_1$ and $\chi_1$ for the lower circle, and $\delta_2$ and $\chi_2$ for the upper circle:

$$d_i = \sqrt{x_i^2 + z_i^2}$$

$$\cos(\chi_i) = \frac{z_i}{d_i}$$

where $i$ is the index number of a given circle.

Radii of the Circles (2 coordinates)

These are stored as $r_1$ and $r_2$.

Tilt Angles of the Circles (2 coordinates)

These are stored as $\phi_1$ and $\phi_2$.

Sector Angles (2 coordinates)

These are measured clockwise from the y axis and are stored as $\delta_a$ and $\delta_b$:

$$\delta_k = 2\pi \frac{k}{N_s}$$

where $k$ is the index number of a given sector within the current frustum.

2: Height and Width of Sector

The co-ordinates of the four corners of the sector are obtained in Cartesian co-ordinates:

$$\mathbf{a}_{lm} = \begin{pmatrix} d_l \sin \chi_l - r_l \cos \delta_m \cos \phi_l \\ r_l \sin \delta_m \\ d_l \cos \chi_l - r_l \cos \delta_m \sin \phi_l \end{pmatrix}, \qquad l, m = 1,2$$

From the coordinates, the height $h_k$ and the width $w_k$ are given by:

$$h_k = \frac{1}{2}\left(\left|\mathbf{a}_{11} - \mathbf{a}_{21}\right| + \left|\mathbf{a}_{12} - \mathbf{a}_{22}\right|\right)$$

$$w_k = \frac{1}{2}\left(\left|\mathbf{a}_{22} - \mathbf{a}_{21}\right| + \left|\mathbf{a}_{12} - \mathbf{a}_{11}\right|\right)$$

3: Surface Area of Sector

The surface area of the sector is given by:

$$A_k = h_k w_k$$

- Emissive Power of the Flame

The surface emissive power of the flame, $E_m$, is calculated from Cook et al. (1990) as:

$$E_m = \frac{F_s Q H_{\mathrm{Comb}}}{A^{\mathrm{Total}}}$$

where $F_s$ the fraction of heat radiated, $Q$ is the mass discharge rate, $H_{comb}$ is the heat of combustion (obtained from the Properties Library), and $A^{Total}$ is the total surface area of the flame.

If the calculated value of $E_m$ is greater than the maximum surface emissive power set as a parameter, then the maximum value from the parameters is used instead.

*Radiation*
Calculations for all radiation scenarios given later.

**BLEVE Modeling**
There are five main parts of the calculations:

- Flammable Mass
- Flame Shape
- Duration
- Flame Emissive Power
- Radiation

*Calculating the Flammable Mass*
The flammable mass involved in the BLEVE is calculated as:

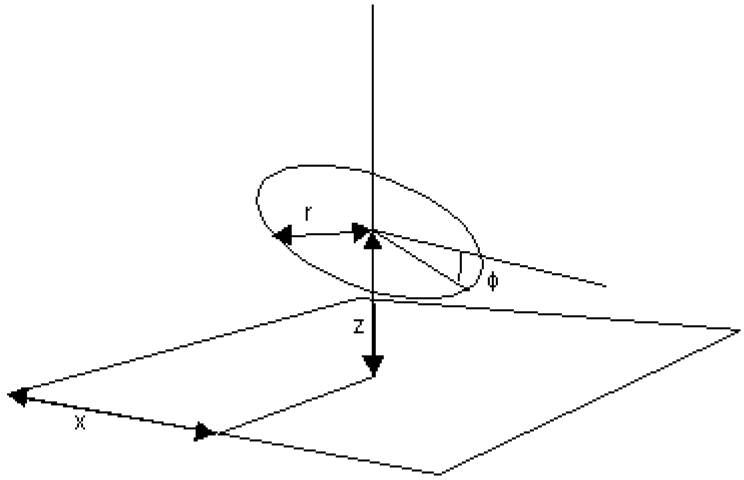
$$M_{BLEVE} = M_{Release} \cdot f_{flam}$$

$$f_{flam} = \min\left\{1, R_{fire}\left(1 - f_{rainout}\right)\right\}$$

where $M_{Release}$ is the mass released, $R_{fire}$ is the BLEVE Mass Modification Factor, set in the BLEVE tab section for the Model, and $f_{rainout}$ is the rainout fraction calculated in the discharge modeling.

If the Model is for a continuous release and the total duration is less than the value set for the Time to BLEVE in the Parameters, then the flammable mass is given by: Release Rate x Duration

*Calculating the Flame Shape*
The flame is modeled as a sphere, and its shape is described by ten circles (c1 to c10) equally spaced along the flame length (i.e. along the diameter of the flame). Each circle is defined by the downwind coordinate *x* and elevation *z* of the centre of the circle, by the radius *r*, and by the inclination of the circle from the horizontal $\phi$, as shown in the illustration below:




- Flame Radius

The flame radius, $r_{Flame}$, is calculated from Crossthwaite et al. (1982) as:

$$r_{Flame} = 2.9 M_{Bleve}^{\frac{1}{3}}$$

- Flame Shape Circles

The pool fire is defined by ten circles; this method of describing flames shapes is also used for Pool Fires and Jet Flames.

For each of the *N* (i.e. 10) circles, the co-ordinates are calculated as:

$$x_i = 0 \quad z_i = r_{\text{Flame}} \left(1 - \cos \theta_i\right) \quad r_i = r_{\text{Flame}} \sin \theta_i \quad \varphi_i = 0$$

where:

$$\theta_i = \frac{\pi(i-1)}{N-1}$$

The bottom and the top circles have zero radius, and are added to complete the surface of the flame. The radiation calculations treat the flame as a set of conical surfaces, where each conical surface is bounded by two circles, and these two circles ensure that the entire flame is treated as a radiating surface.

*Calculating the Duration*

The flame duration, $t_{Flame}$, is calculated from Crossthwaite et al. (1982) as:

$$t_{Flame} = \begin{cases} 0.45 M_{Bleve}^{\frac{1}{3}} & M_{Bleve} < 37000 \\ 2.59 M_{Bleve}^{\frac{1}{6}} & 37000 \le M_{Bleve} \end{cases}$$

*Calculating the Emissive Power*
The fraction of heat radiated from the surface of the flame, $f_s$, is calculated from Roberts (1982) as:

$$f_s = 0.27\left(\frac{P_{Sat}}{10P_{Atm}}\right)^{0.32}$$

$$P_{sat} = \begin{cases} P_{atm} & P_{atm} > P_{svp} \\ P_{svp} & P_{atm} < P_{svp} \end{cases}$$

where $P_{svp}$ (the saturation vapor pressure of the substance) is calculated using the Properties Library at the lower of the atmospheric temperature and the critical temperature.

The emissivity or emissive power, $E_f$ , is then calculated from DNV (1992) as:

$$E_f = \frac{f_s M_{Bleve} H_{Comb}}{4\pi r_{Flame}^2 t_{Flame}}$$

If the calculated emissivity is greater than $E_{max}$, the maximum emissive power for BLEVEs set in the Parameters, then $E_f$ is set to $E_{max}$.

*Radiation*
Calculations for all radiation scenarios given later.

**TNT Explosion Modelling**
There are four main parts to the calculations:

- Equivalent Mass of TNT
- Overpressure at Distances of Interest
- Radius to Overpressures of Interest
- Graph of Overpressure vs. Distance

*Equivalent Mass of TNT*
If the flammable mass in the cloud is less than the Minimum Explosive Mass set in the Parameters, then no explosion will occur, and the modeling is not performed.

The program calculates the mass of TNT that is equivalent to the effective flammable mass in the cloud:

$$m_{TNT} = \left(\frac{H_{Combustion}}{H_{TNT}}\right) m_{eff}$$

$$m_{eff} = \min\{f_{vapor} F_{mod}, 1\} M_{flam} X' f_e$$

where $H_{TNT}$ is the heat of combustion of TNT without air (4.7 x 106 J kg-1), $f_{vapor}$ is the post-flash vapor fraction, $F_{mod}$ is the Early Explosion Mass Modification Factor, taken from the Flammable tab section, $M_{flam}$ is the total flammable mass in the release, $X'$ is the explosion efficiency, taken from the Properties Library if a value has been set for the release material, or from the input data if there is no value in the Properties Library, and $f_e$ is the ground reflection factor, set to 1 for an air burst, and 2 for a ground burst.

*Overpressure at Distances of Interest*
In the Location tab section, you can set up to three distances of interest. For each distance, the program performs the following calculations:

Explosion Radius

The explosion radius, *R'*, is the distance from the explosion center to the distance of interest:

$$R' = d_i^{\text{Input}} - d_{\text{Explosion}}$$

Overpressure
If $mX'H_{combustion}$ is less than 103 J then the overpressure is set to zero. Otherwise, the overpressure $P_o$ is calculated using an approximation of the Kingery and Bulmash curves as published in Lees (1996):

$$\log_{10} P_o = a(\log_{10} z)^2 + b\log_{10} z + c$$

where:

a = 0.2518, b = -2.20225, c = 5.8095

$$z = \frac{R'}{m_{TNT}^{1/3}}$$

*Distance to Overpressures of Interest*
There are three overpressures of interest set in the Parameters. For each overpressure of interest, the program performs the following calculations:

Explosion Radius

The explosion radius *R'* is calculated from:

$$R' = zm_{TNT}^{1/3}$$

where:

$$\log_{10} z = \left(\frac{-b - \sqrt{b^2 - 4a(c - \log_{10} P_o)}}{2a}\right)$$

and a = 0.2518, b = -2.20225 and c = 5.8095.

Distance from Release Source

The distance to the overpressure from the release source is then calculated as:

$$d_i^{\text{Output}} = R' + d_{\text{Explosion}}$$

*Overpressures for Graph versus Distance*
The program considers up to 50 steps from the release location to a maximum distance $d_{max}$, where the explosion radius for a given step is calculated as:

$$R' = d_{\text{Start}} + (i-1)d_{\text{Step}} - d_{\text{Explosion}}$$

The overpressures for the graph versus distance are then calculated in the same way as the overpressures for the distances of interest.

**Late Pool Fire**
The program takes the state of the evaporating pool at the time when it reaches its largest diameter, and uses the Pool Fire modeling to calculate the size, shape and intensity of the flame, and then calculates the size of the contours to the three radiation levels that are set in the Pool Fire tab section for the Case.

**Late Explosion**
The program calculates the effects of explosion at different times during the course of the release and dispersion. These times are chosen to give particular values for the Explosion Center, placing it at regular intervals set by the Results Grid Step in the Parameters. For an instantaneous release, the Cloud Location is chosen so that the sum of the Location and the Cloud Width to the flammable limit gives the appropriate Explosion Center.

For each time, the program calculates the mass in the flammable region of the cloud, where the definition of the flammable region is set in the Parameters. It then uses this mass in the appropriate Explosion Model (selected for the Source Model in the Flammable tab section), to calculate the distance from the center of the explosion to each of the three explosion overpressures set in the Parameters.

Finally, the program calculates the maximum downwind distance to each of the three overpressures, using the Explosion Location Criterion (set in the Parameters) to obtain the center of the explosion in relation to the dimensions and concentration profile of the cloud.

**Toxic Effects**
The program calculates the toxic effects at a range of distances downwind. For each distance, the program considers the full time-history of the concentration at that location over the course of the release and dispersion, and calculates the Toxic Dose received at that location, where the Dose is cNt in the probit equation:

$$\text{Pr} = A + B \ln\left(c^N t\right)$$

where *c* is the concentration in ppm, *t* is the duration in minutes, and *A*, *B* and *N* are toxic properties for the material.

Given the Total Dose, the program calculates the Probit value for the location, and from this the Lethality at the location. It also calculates the Equivalent Concentration for the location, which is the concentration that would give the same dose as the calculated Total Dose, if the duration of the exposure was equal to the Averaging

Time for the Concentration of Interest (set in the Location tab section), instead of the actual exposure time.

**Calculating a Radiation Ellipse**

This considers a horizontal plane at ground level, and calculates the dimensions of the ellipse that connects points that have a given view factor, radiation level, or lethality level. In reality, the contour that connects these points might not be perfectly elliptical, but the ellipse is a common and useful approximation.

The calculations can be divided into four main stages:

1: Convert Radiation to View Factor
2: Is View Factor within Limits?
3: Find Flame Boundary
4: Search for Locations with Required View Factor

*Stage 1: Convert Radiation to View Factor*

The program first calculates the view factor that corresponds to the radiation level for the ellipse. If the flame emissive power is greater than one, then the view factor is defined as below, else the view factor is made equal to the flame emissive power:

$$V_f = \frac{R_i}{F_e}$$

*Stage 2: Check View Factor Against Limits*

The program has a maximum value for the view factor, currently set as 0.9. If the view factor is above this maximum value, the program sets the ellipse to be extent of the flame itself, or an elliptical approximation. The form of the ellipse which describes the flame depends on the type of the flame:

For Pool Fire

Length of major semi-axis (a) $r_1$
Length of minor semi-axis (b) $r_1$
Fractional displacement (d) 0.0

where $r_1$ is the radius of the lower disk which describes the flame shape.

For Jet Fire

Length of major semi-axis (a) Half flame length
Length of minor semi-axis (b) Radius of largest flame shape circle
Fractional displacement (d) 1.0

For BLEVE

| | | |
|---|---|---|
| Length of major semi-axis (a) | 0 | $1 \le V_f$ |
| | $r_{Flame}\sqrt{\frac{1}{V_f} - 1}$ | $10^{-6} \le V_f < 1$ |
| | $r_{Flame}$ | $V_f < 10^{-6}$ |
| Length of minor semi-axis (b) | a | |
| Fractional displacement (d) | 0.0 | |

If the view factor is below $10^{-6}$ then the three ellipse parameters are set to zero.

If the view factor is within the limits, then the program proceeds to the next stage.

*Stage 3: Locate Flame Boundary at Ground Level*
The program finds the length of the downwind axis of the ellipse by considering the line pointing directly downwind (i.e. y = 0) through the flame centre at z = 0, and searching for the two points along the line which have a view factor equal to the desired value. To make the search more efficient, the program first identifies the points where the line crosses the flame boundary, since the view factor is bound to be above the desired value as these points, and the search can ignore locations inside the flame boundary.

To determine where the line crosses the flame boundary, the program first loops over all the circles that define the flame shape. The upwind and downwind extents of each circle are calculated as:

$$x_i^{(\text{Downwind})} = x_i + (r_i + 0.2)\cos \theta_i$$

$$x_i^{(\text{Upwind})} = x_i - (r_i + 0.2)\cos \theta_i$$

The program stores the maximum value of $x_i^{(Downwind)}$ and the minimum value of $x_i^{(Upwind)}$ for circles that have zero elevation, and also stores the maximum value of $x_i^{(Downwind)}$ for any circle in case no circle has zero elevation.

The program also searches for the maximum extent of the flame in the cross-wind direction, which is the maximum value of ($r_i$ + 0.2) for circles with zero height.

The program then loops over the flame-defining circles in pairs, and constructs a quadrangle which is the cross-section of the flame (as defined by the two circles) along the plane y = 0. If any of the four sides of this quadrangle cross the z = 0 plane, then the x value at this crossing is calculated. If ($x_{crossing}$ - 0.2) is less than the current minimum value of $x_i^{(Upwind)}$ then the program updates $x_i^{(Upwind)}$. If ($x_{crossing}$ + 0.2) is greater than the current maximum value of $x_i^{(Downwind)}$ then the program updates $x_i^{(Downwind)}$.

If the flame does not cross the ground, then the program performs an iterative search for the upwind and downwind points along the line (y = 0, z = 0) where the view factor is maximum, and these are used as the inward limits for the search for the required view factor.

*Stage 4: Search for Required View Factor and Calculate Ellipse Parameters*
The program now has inward limits for the upwind, downwind and crosswind directions, and can start to search outward for the locations where the view factor reaches the required value.

It performs the search for each direction in turn:

Downwind Direction

A successful search will return a value for $x_{Downwind}$. If the search fails because the required view factor was greater than the maximum view factor for the flame, then the program sets $x_{Downwind}$ as follows:

| Flame Type | $x_{Downwind}$ |
|---|---|
| Jet Fire | 0 |
| Pool Fire | Downwind extent of flame |

If the flame model is BLEVE, then the ellipse reduces to a circle, with the length of the major and minor semi-axes both set equal to $x_{Downwind}$, and the fractional displacement *d* set to zero. For the other types of flame, the program proceeds to the next direction.

Upwind Direction

A successful search will return a value for $x_{Upwind}$. If the search fails because the required view factor was greater than the maximum view factor for the flame, then the program sets $x_{Upwind}$ as follows:

| Flame Type | $x_{Upwind}$ |
|---|---|
| Jet Fire | 0 |
| Pool Fire | Upwind extent of flame |

Given $x_{Downwind}$ and $x_{Upwind}$, the program can calculate the ellipse parameters as follows:

$$a = \begin{cases} 0 & x^{(Downwind)} - x^{(Upwind)} \leq 0 \\ \dfrac{x^{(Downwind)} - x^{(Upwind)}}{2} & 0 < x^{(Downwind)} - x^{(Upwind)} \end{cases}$$

$$d = \begin{cases} 0 & a \leq 0 \\ \dfrac{x^{(Downwind)} + x^{(Upwind)}}{2a} & 0 < a \end{cases}$$

where *d* is the fractional displacement.

Crosswind Direction

For the crosswind direction, the program searches along the line through the flame center with x fixed at the center of the ellipse defined above. The value returned, $x_{Crosswind}$, is the length of the minor semi-axis, *b*.

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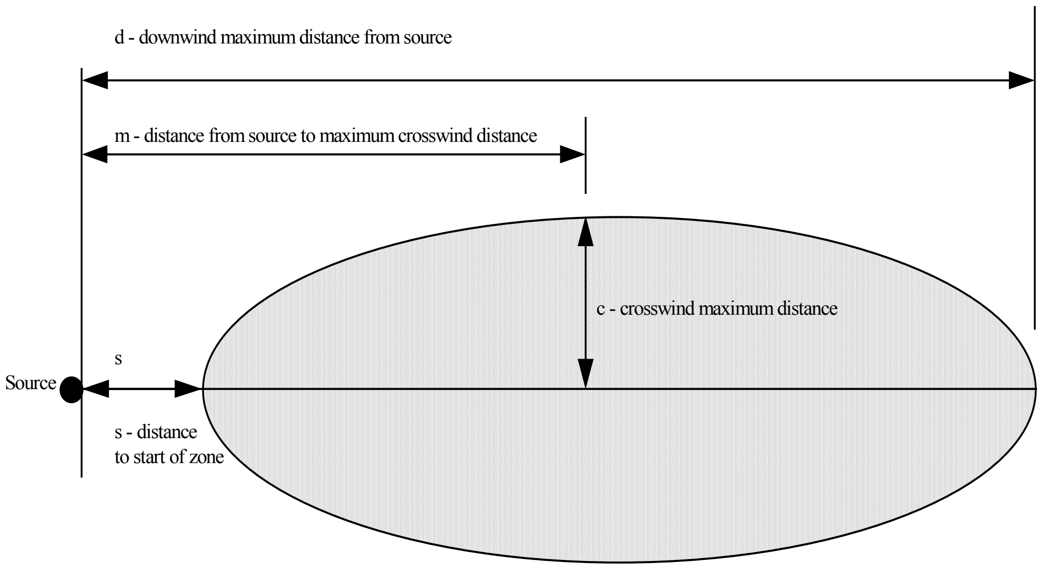
# APPENDIX K Risk Summation Using Riskplot II

**Summary of Consequence and Frequency Analysis**
In order to introduce the Riskplot II analysis, it is necessary to briefly summarise the Consequence and Frequency Analysis Sections. This describes the calculation of fire and explosion and toxic event frequencies and magnitudes. In this section, release frequencies from each isolatable section of the process were quantified. Firstly, each isolatable section was examined and the number of potential leak sources were summed; then, generic leak frequencies were applied to arrive at an overall leak frequency.
A leak size distribution was applied to each leak frequency in order to estimate the relative numbers of small, medium and large leaks.
Event outcomes were identified during the course of modelling the consequences of the leak sizes, using the DNV consequence modelling package Phast. These were as follows:

- jet fires;
- flash fires / fireballs;
- vapour cloud explosions; and
- toxic cloud dispersion.

Ignition probabilities for immediate and delayed ignition were used on the basis of predicted mass flow by using empirical relationships. For instances of delayed ignition, other empirical relationships were used to estimate the relative likelihood of explosion compared to vapour cloud fire / fireball.

***Figure B2.1: Riskplot II Consequence Effect Dimensions***




The magnitude of each event is quantified in terms of effect distances to specified intensities of either fire radiation or blast overpressure. These intensities are defined in terms of fatality criteria, which are in turn defined in terms of a probability of fatality for an exposed individual: for example, an individual exposed to 37.5 kW/m2 is 78% likely to become an immediate fatality; exposure to 20 kW/m2 is 14% likely; and so on.

For each event, four effect parameters are calculated: d, c, s and m. These correspond to effect distances as shown in Figure B2.1.

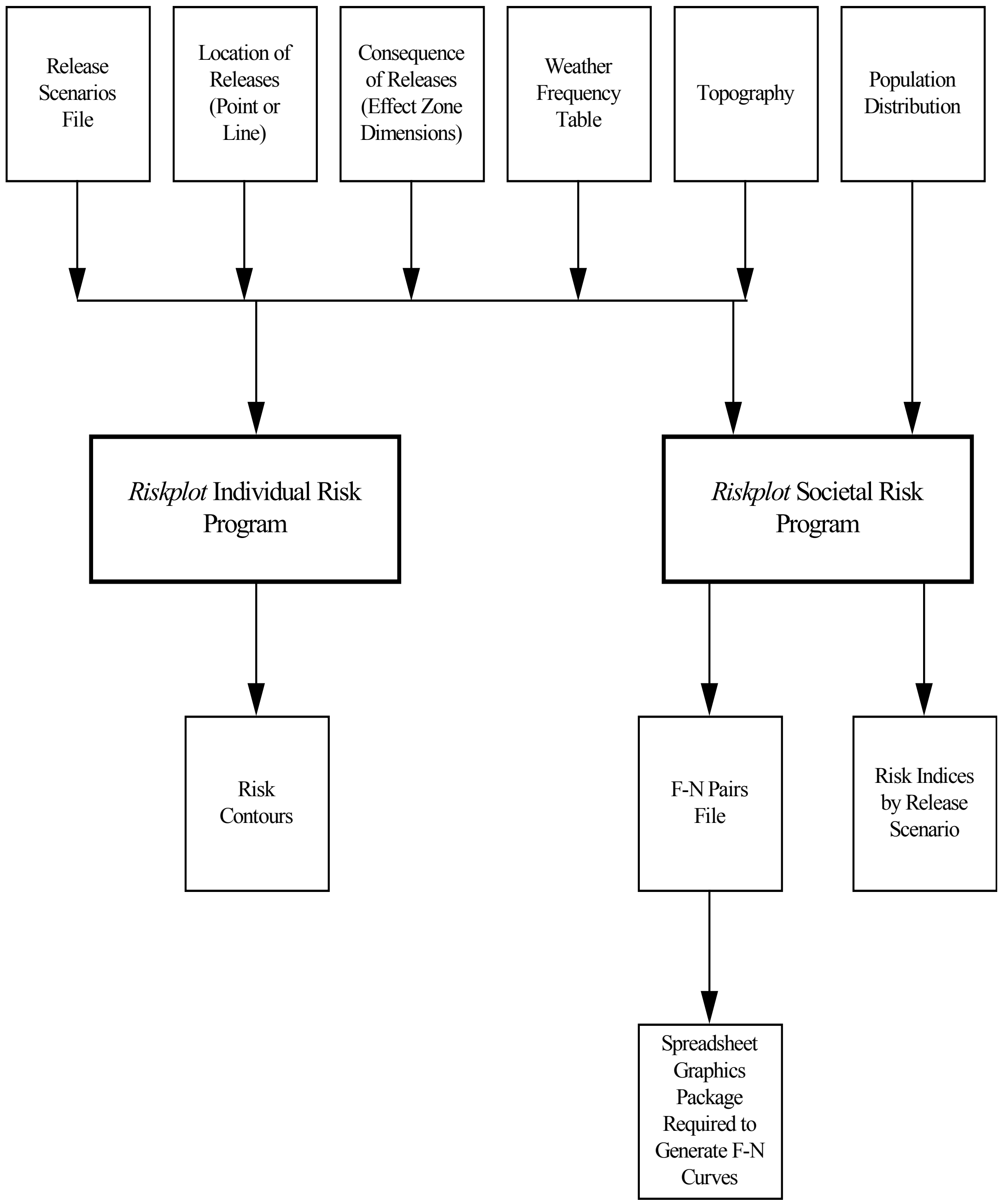
These dimensions are used to calculate on site and offsite risk in the package Riskplot II as described below.

**Riskplot II analysis overview**

Riskplot II is basically a risk summation tool which locates the site giving rise to flammable and toxic risk on a grid. The location of each source of release is defined by coordinates on the grid, and likewise the population at risk. Site-specific factors are then accounted for. Finally, the risk is calculated in terms of individuals and the defined population groups.

A schematic diagram of the Riskplot II methodology is shown in Figure B2.2. This is the diagram that is supplied as part of the user documentation: only a certain number of the facilities that Riskplot II offers are used for this study.

*Figure B2.2 : Riskplot II Schematic Flowsheet*



# APPENDIX L Sensitivity Analysis

WA-DMPR have requested that pipe ruptures (within the plant) be considered in the PRA. Due to this late change a sensitivity study was conducted to determine the affect of including pipe ruptures would have on the risk results.

This study assumed each isolatable section has 200m of 200mm diameter piping, with the exception of the export pipeline (which has already been modelled as a rupture).

The frequency for the pipe ruptures was derived from the release frequency for 4” to 11” oil and gas pipework given in E&P Forum [7]. The resulting total release frequencies are summarised in the table below.

The resulting risk contours are illustrated in Appendix N and can be compared to the original contours in Appendix M. The societal risk curves are included in Section 6 of the report.

The risk contours did increase marginally, but did not introduce any new concerns in relation to the offsite risk. The 50E-6 contour still lies within the plant boundary and the 10E-6 contour exceeds the plant boundary to the north and south of the plant marginally more than the last given contours.

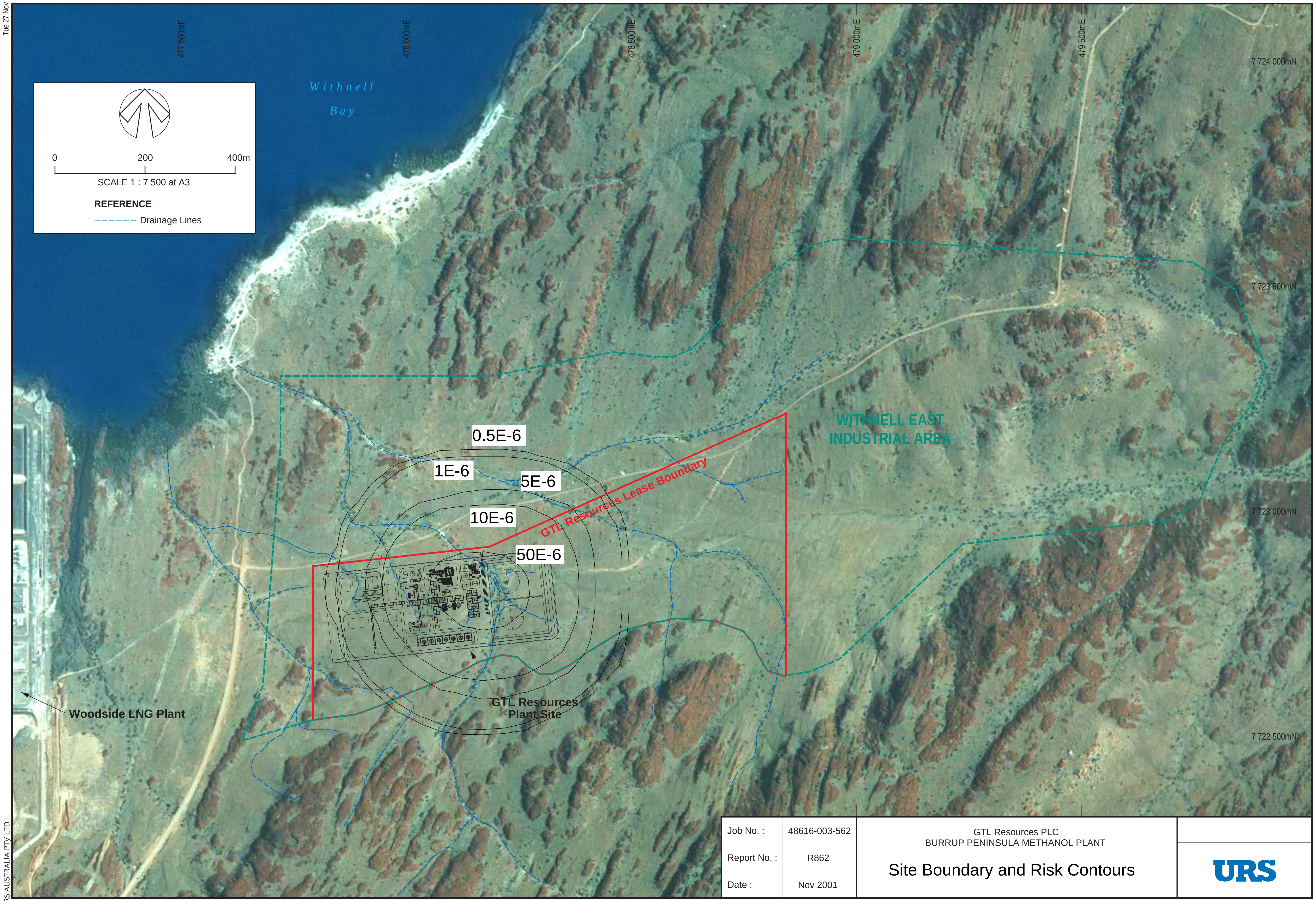
The societal risk curve did not change for this sensitivity analysis.

Therefore the plant is still considered to comply with the EPA Criteria [5].

***Total Release Frequencies***

| Leak Point | 7mm release | 22mm release | 70mm release | Rupture | TOTAL |
|---|---|---|---|---|---|
| ISO1 | 7.64E-01 | 7.46E-02 | 2.01E-02 | 3.61E-04 | 8.59E-01 |
| ISO2 | 6.71E-02 | 1.54E-02 | 5.77E-03 | 3.65E-04 | 8.87E-02 |
| ISO3 | 7.89E-03 | 2.87E-03 | 8.34E-04 | 3.60E-04 | 1.20E-02 |
| ISO4 | 1.96E-01 | 4.55E-02 | 1.17E-02 | 3.65E-04 | 2.54E-01 |
| ISO5 | 1.21E-01 | 2.21E-02 | 5.75E-03 | 3.63E-04 | 1.50E-01 |
| ISO6 | 1.33E-02 | 4.37E-03 | 1.70E-03 | 3.61E-04 | 1.97E-02 |
| ISO7 | 3.25E-02 | 3.33E-03 | 8.63E-04 | 3.61E-04 | 3.71E-02 |
| ISO8 | 3.80E-03 | 1.24E-03 | 2.35E-04 | 3.60E-04 | 5.64E-03 |
| ISO9 | 2.62E-01 | 4.95E-02 | 1.30E-02 | 3.71E-04 | 3.25E-01 |
| ISO10 | 3.07E-02 | 3.01E-03 | 5.16E-04 | 3.66E-04 | 3.46E-02 |
| ISO11 | 3.41E-02 | 1.16E-02 | 4.65E-03 | 3.60E-04 | 5.08E-02 |
| ISO12 | 3.70E-02 | 5.34E-03 | 1.89E-03 | 6.00E-06 | 4.43E-02 |
| ISO13 | 2.08E-02 | 6.98E-03 | 2.50E-03 | 3.60E-04 | 3.07E-02 |
| ISO14 | 3.01E-02 | 2.87E-03 | 7.67E-04 | 6.00E-06 | 3.38E-02 |
| ISO15 | 3.11E-03 | 7.66E-04 | 8.00E-05 | 3.60E-04 | 4.31E-03 |
| ISO16 | 5.31E-03 | 1.31E-03 | 4.42E-04 | 3.60E-04 | 7.42E-03 |
| ISO17 | 5.40E-02 | 3.56E-03 | 4.51E-04 | 3.66E-04 | 5.83E-02 |
| ISO18 | 6.01E-02 | 5.50E-03 | 2.74E-03 | 3.80E-04 | 6.87E-02 |

# APPENDIX M Risk Contours




| | | |
|---|---|---|
| Job No. : | 48616-003-562 | GTL Resources PLC<br>BURRUP PENINSULA METHANOL PLANT |
| Report No. : | R862 | Site Boundary and Risk Contours |
| Date : | Nov 2001 | |

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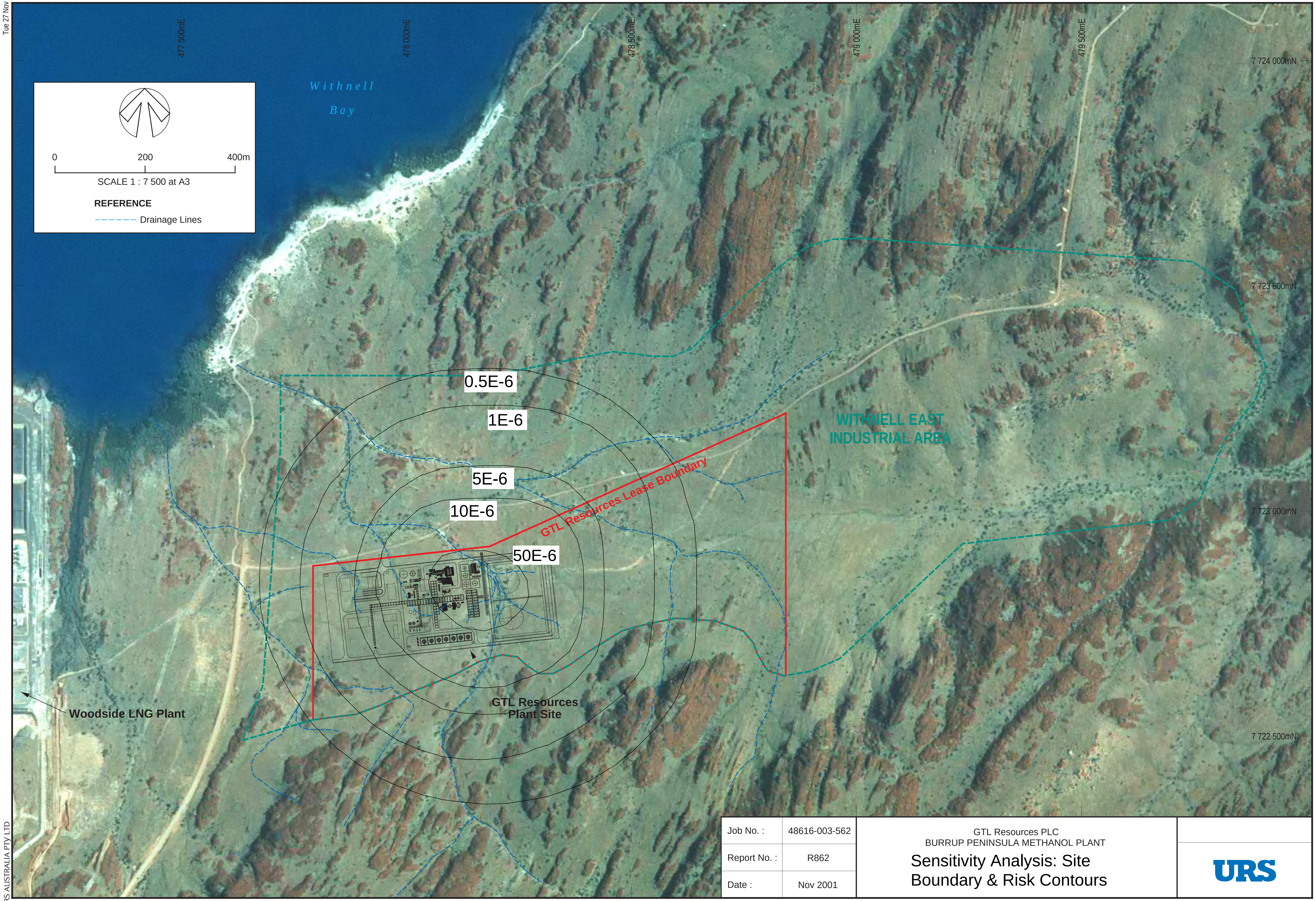
# APPENDIX N Risk Contours for the Sensitivity Analysis

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# APPENDIX O Table of Consequences

| Section | Event | Shutdown Method | Release Size | Frequency | Frequency (Sensitivity analysis) |
|---|---|---|---|---|---|
| 01 | Explosion from initialy uniginited release | Manual shutdown | Large release | 3.527E-06 | 3.464E-06 |
| 01 | Explosion from initialy uniginited release | Shutdown failure | Large release | 7.124E-08 | 6.999E-08 |
| 01 | Jet fire from release of flammable gas | Manual shutdown | Large release | 3.527E-06 | 3.464E-06 |
| 01 | Jet fire from release of flammable gas | Shutdown failure | Large release | 6.412E-07 | 6.299E-07 |
| 01 | Jet fire from release of flammable gas | Manual shutdown | Medium release | 6.010E-07 | 6.010E-07 |
| 01 | Jet fire from release of flammable gas | Shutdown failure | Medium release | 6.010E-07 | 6.010E-07 |
| 01 | BLEVE from initially uniginited release | Manual shutdown | Rupture | 4.523E-11 | 1.248E-08 |
| 01 | BLEVE from initially uniginited release | Shutdown failure | Rupture | 4.569E-13 | 1.260E-10 |
| 01 | Explosion from initialy uniginited release | Manual shutdown | Rupture | 4.523E-11 | 1.248E-08 |
| 01 | Explosion from initialy uniginited release | Shutdown failure | Rupture | 4.569E-13 | 1.260E-10 |
| 01 | Jet fire from release of flammable gas | Manual shutdown | Rupture | 4.523E-11 | 1.248E-08 |
| 01 | Jet fire from release of flammable gas | Shutdown failure | Rupture | 4.523E-11 | 1.248E-08 |
| 01 | Jet fire from release of flammable gas | Manual shutdown | Small release | 8.798E-07 | 8.798E-07 |
| 01 | Jet fire from release of flammable gas | Shutdown failure | Small release | 8.798E-07 | 8.798E-07 |
| 02 | Explosion from initialy uniginited release | Manual shutdown | Large release | 2.118E-07 | 1.993E-07 |
| 02 | Explosion from initialy uniginited release | Shutdown failure | Large release | 6.417E-09 | 6.041E-09 |
| 02 | Jet fire from release of flammable gas | Manual shutdown | Large release | 2.097E-05 | 1.973E-05 |
| 02 | Jet fire from release of flammable gas | Shutdown failure | Large release | 2.075E-07 | 1.953E-07 |
| 02 | Jet fire from release of flammable gas | Manual shutdown | Medium release | 1.232E-05 | 1.232E-05 |
| 02 | Jet fire from release of flammable gas | Shutdown failure | Medium release | 1.244E-07 | 1.244E-07 |
| 02 | Explosion from initialy uniginited release | Manual shutdown | Rupture | 1.086E-09 | 7.567E-08 |
| 02 | Explosion from initialy uniginited release | Shutdown failure | Rupture | 1.828E-11 | 1.274E-09 |
| 02 | Jet fire from release of flammable gas | Manual shutdown | Rupture | 1.701E-08 | 1.185E-06 |
| 02 | Jet fire from release of flammable gas | Shutdown failure | Rupture | 1.645E-10 | 1.147E-08 |
| 02 | Jet fire from release of flammable gas | Manual shutdown | Small release | 7.648E-06 | 7.648E-06 |
| 02 | Jet fire from release of flammable gas | Shutdown failure | Small release | 7.725E-08 | 7.725E-08 |
| 03 | Explosion from initialy uniginited release | Manual shutdown | Large release | 4.121E-08 | 2.878E-08 |
| 03 | Explosion from initialy uniginited release | Shutdown failure | Large release | 1.249E-09 | 8.722E-10 |
| 03 | Jet fire from release of flammable gas | Manual shutdown | Large release | 4.080E-06 | 2.849E-06 |

| Section | Event | Shutdown Method | Release Size | Frequency | Frequency (Sensitivity analysis) |
|---|---|---|---|---|---|
| 03 | Jet fire from release of flammable gas | Shutdown failure | Large release | 4.038E-08 | 2.820E-08 |
| 03 | Jet fire from release of flammable gas | Manual shutdown | Medium release | 2.287E-06 | 2.287E-06 |
| 03 | Jet fire from release of flammable gas | Shutdown failure | Medium release | 2.310E-08 | 2.310E-08 |
| 03 | Explosion from initialy uniginited release | Manual shutdown | Rupture | 0.000E+00 | 7.458E-08 |
| 03 | Explosion from initialy uniginited release | Shutdown failure | Rupture | 0.000E+00 | 1.256E-09 |
| 03 | Jet fire from release of flammable gas | Manual shutdown | Rupture | 0.000E+00 | 1.168E-06 |
| 03 | Jet fire from release of flammable gas | Shutdown failure | Rupture | 0.000E+00 | 1.130E-08 |
| 03 | Jet fire from release of flammable gas | Manual shutdown | Small release | 8.992E-07 | 8.992E-07 |
| 03 | Jet fire from release of flammable gas | Shutdown failure | Small release | 9.083E-09 | 9.083E-09 |
| 04 | Explosion from initialy uniginited release | Manual shutdown | Large release | 4.162E-07 | 4.038E-07 |
| 04 | Explosion from initialy uniginited release | Shutdown failure | Large release | 4.204E-09 | 4.078E-09 |
| 04 | Jet fire from release of flammable gas | Manual shutdown | Large release | 4.120E-05 | 3.997E-05 |
| 04 | Jet fire from release of flammable gas | Shutdown failure | Large release | 4.162E-07 | 4.038E-07 |
| 04 | Explosion from initialy uniginited release | Manual shutdown | Medium release | 3.668E-07 | 3.668E-07 |
| 04 | Explosion from initialy uniginited release | Shutdown failure | Medium release | 3.705E-09 | 3.705E-09 |
| 04 | Jet fire from release of flammable gas | Manual shutdown | Medium release | 3.631E-05 | 3.631E-05 |
| 04 | Jet fire from release of flammable gas | Shutdown failure | Medium release | 3.668E-07 | 3.668E-07 |
| 04 | Explosion from initialy uniginited release | Manual shutdown | Rupture | 2.352E-10 | 1.640E-08 |
| 04 | Explosion from initialy uniginited release | Shutdown failure | Rupture | 1.170E-11 | 8.153E-10 |
| 04 | Jet fire from release of flammable gas | Manual shutdown | Rupture | 1.786E-08 | 1.245E-06 |
| 04 | Jet fire from release of flammable gas | Shutdown failure | Rupture | 1.711E-10 | 1.192E-08 |
| 04 | Jet fire from release of flammable gas | Manual shutdown | Small release | 2.236E-05 | 2.236E-05 |
| 04 | Jet fire from release of flammable gas | Shutdown failure | Small release | 2.258E-07 | 2.258E-07 |
| 05 | Toxic gas release (CO) | Manual shutdown | Rupture | 9.810E-07 | 9.810E-07 |
| 05 | Toxic gas release (CO) | Shutdown failure | Rupture | 4.260E-10 | 4.260E-10 |
| 05 | Explosion from initialy uniginited release | Manual shutdown | Large release | 4.222E-07 | 3.973E-07 |
| 05 | Explosion from initialy uniginited release | Shutdown failure | Large release | 2.132E-08 | 2.007E-08 |
| 05 | Jet fire from release of flammable gas | Manual shutdown | Large release | 2.069E-05 | 1.947E-05 |
| 05 | Jet fire from release of flammable gas | Shutdown failure | Large release | 1.919E-07 | 1.806E-07 |
| 05 | Explosion from initialy uniginited release | Manual shutdown | Medium release | 1.783E-07 | 1.783E-07 |

| Section | Event | Shutdown Method | Release Size | Frequency | Frequency (Sensitivity analysis) |
|---|---|---|---|---|---|
| 05 | Explosion from initialy uniginited release | Shutdown failure | Medium release | 1.801E-09 | 1.801E-09 |
| 05 | Jet fire from release of flammable gas | Manual shutdown | Medium release | 1.765E-05 | 1.765E-05 |
| 05 | Jet fire from release of flammable gas | Shutdown failure | Medium release | 1.783E-07 | 1.783E-07 |
| 05 | Explosion from initialy uniginited release | Manual shutdown | Rupture | 9.047E-10 | 1.252E-07 |
| 05 | Explosion from initialy uniginited release | Shutdown failure | Rupture | 9.138E-12 | 1.265E-09 |
| 05 | Jet fire from release of flammable gas | Manual shutdown | Rupture | 8.142E-09 | 1.127E-06 |
| 05 | Jet fire from release of flammable gas | Shutdown failure | Rupture | 8.224E-11 | 1.138E-08 |
| 05 | Jet fire from release of flammable gas | Manual shutdown | Small release | 1.382E-05 | 1.382E-05 |
| 05 | Jet fire from release of flammable gas | Shutdown failure | Small release | 1.396E-07 | 1.396E-07 |
| 06 | Explosion from initialy uniginited release | Manual shutdown | Large release | 7.099E-08 | 5.856E-08 |
| 06 | Explosion from initialy uniginited release | Shutdown failure | Large release | 7.171E-10 | 5.915E-10 |
| 06 | Poolfire from the release of liquid hydrocarbons | Manual shutdown | Large release | 7.028E-06 | 5.797E-06 |
| 06 | Poolfire from the release of liquid hydrocarbons | Shutdown failure | Large release | 7.099E-08 | 5.856E-08 |
| 06 | Explosion from initialy uniginited release | Manual shutdown | Medium release | 3.521E-08 | 3.521E-08 |
| 06 | Explosion from initialy uniginited release | Shutdown failure | Medium release | 3.557E-10 | 3.557E-10 |
| 06 | Poolfire from the release of liquid hydrocarbons | Manual shutdown | Medium release | 3.486E-06 | 3.486E-06 |
| 06 | Poolfire from the release of liquid hydrocarbons | Shutdown failure | Medium release | 3.521E-08 | 3.521E-08 |
| 06 | Explosion from initialy uniginited release | Manual shutdown | Rupture | 4.523E-11 | 1.248E-08 |
| 06 | Explosion from initialy uniginited release | Shutdown failure | Rupture | 4.569E-13 | 1.260E-10 |
| 06 | Poolfire from the release of liquid hydrocarbons | Manual shutdown | Rupture | 4.478E-09 | 1.235E-06 |
| 06 | Poolfire from the release of liquid hydrocarbons | Shutdown failure | Rupture | 4.523E-11 | 1.248E-08 |
| 06 | Poolfire from the release of liquid hydrocarbons | Manual shutdown | Small release | 1.510E-06 | 1.510E-06 |
| 06 | Poolfire from the release of liquid hydrocarbons | Shutdown failure | Small release | 1.525E-08 | 1.525E-08 |
| 07 | Explosion from initialy uniginited release | Manual shutdown | Large release | 4.222E-08 | 2.979E-08 |
| 07 | Explosion from initialy uniginited release | Shutdown failure | Large release | 4.264E-10 | 3.009E-10 |
| 07 | Poolfire from the release of liquid hydrocarbons | Manual shutdown | Large release | 4.180E-06 | 2.949E-06 |
| 07 | Poolfire from the release of liquid hydrocarbons | Shutdown failure | Large release | 4.222E-08 | 2.979E-08 |
| 07 | Explosion from initialy uniginited release | Manual shutdown | Medium release | 2.685E-08 | 2.685E-08 |
| 07 | Explosion from initialy uniginited release | Shutdown failure | Medium release | 2.712E-10 | 2.712E-10 |
| 07 | Poolfire from the release of liquid hydrocarbons | Manual shutdown | Medium release | 2.658E-06 | 2.658E-06 |

| Section | Event | Shutdown Method | Release Size | Frequency | Frequency (Sensitivity analysis) |
|---|---|---|---|---|---|
| 07 | Poolfire from the release of liquid hydrocarbons | Shutdown failure | Medium release | 2.685E-08 | 2.685E-08 |
| 07 | Explosion from initialy uniginited release | Manual shutdown | Rupture | 4.523E-11 | 1.248E-08 |
| 07 | Explosion from initialy uniginited release | Shutdown failure | Rupture | 4.569E-13 | 1.260E-10 |
| 07 | Poolfire from the release of liquid hydrocarbons | Manual shutdown | Rupture | 4.478E-09 | 1.235E-06 |
| 07 | Poolfire from the release of liquid hydrocarbons | Shutdown failure | Rupture | 4.523E-11 | 1.248E-08 |
| 07 | Poolfire from the release of liquid hydrocarbons | Manual shutdown | Small release | 3.706E-06 | 3.706E-06 |
| 07 | Poolfire from the release of liquid hydrocarbons | Shutdown failure | Small release | 3.743E-08 | 3.743E-08 |
| 08 | Explosion from initialy uniginited release | Manual shutdown | Large release | 2.056E-08 | 8.130E-09 |
| 08 | Explosion from initialy uniginited release | Shutdown failure | Large release | 2.077E-10 | 8.213E-11 |
| 08 | Poolfire from the release of liquid hydrocarbons | Manual shutdown | Large release | 2.036E-06 | 8.049E-07 |
| 08 | Poolfire from the release of liquid hydrocarbons | Shutdown failure | Large release | 2.056E-08 | 8.130E-09 |
| 08 | Explosion from initialy uniginited release | Manual shutdown | Medium release | 1.002E-08 | 1.002E-08 |
| 08 | Explosion from initialy uniginited release | Shutdown failure | Medium release | 1.012E-10 | 1.012E-10 |
| 08 | Poolfire from the release of liquid hydrocarbons | Manual shutdown | Medium release | 9.921E-07 | 9.921E-07 |
| 08 | Poolfire from the release of liquid hydrocarbons | Shutdown failure | Medium release | 1.002E-08 | 1.002E-08 |
| 08 | Explosion from initialy uniginited release | Manual shutdown | Rupture | 0.000E+00 | 1.243E-08 |
| 08 | Explosion from initialy uniginited release | Shutdown failure | Rupture | 0.000E+00 | 1.256E-10 |
| 08 | Poolfire from the release of liquid hydrocarbons | Manual shutdown | Rupture | 0.000E+00 | 1.231E-06 |
| 08 | Poolfire from the release of liquid hydrocarbons | Shutdown failure | Rupture | 0.000E+00 | 1.243E-08 |
| 08 | Poolfire from the release of liquid hydrocarbons | Manual shutdown | Small release | 4.329E-07 | 4.329E-07 |
| 08 | Poolfire from the release of liquid hydrocarbons | Shutdown failure | Small release | 4.373E-09 | 4.373E-09 |
| 09 | Explosion from initialy uniginited release | Manual shutdown | Large release | 4.616E-07 | 4.492E-07 |
| 09 | Explosion from initialy uniginited release | Shutdown failure | Large release | 4.663E-09 | 4.537E-09 |
| 09 | Poolfire from the release of liquid hydrocarbons | Manual shutdown | Large release | 4.570E-05 | 4.447E-05 |
| 09 | Poolfire from the release of liquid hydrocarbons | Shutdown failure | Large release | 4.616E-07 | 4.492E-07 |
| 09 | Explosion from initialy uniginited release | Manual shutdown | Medium release | 3.986E-07 | 3.986E-07 |
| 09 | Explosion from initialy uniginited release | Shutdown failure | Medium release | 4.026E-09 | 4.026E-09 |
| 09 | Poolfire from the release of liquid hydrocarbons | Manual shutdown | Medium release | 3.946E-05 | 3.946E-05 |
| 09 | Poolfire from the release of liquid hydrocarbons | Shutdown failure | Medium release | 3.986E-07 | 3.986E-07 |
| 09 | Explosion from initialy uniginited release | Manual shutdown | Rupture | 5.953E-10 | 1.282E-08 |

| Section | Event | Shutdown Method | Release Size | Frequency | Frequency (Sensitivity analysis) |
|---|---|---|---|---|---|
| 09 | Explosion from initialy uniginited release | Shutdown failure | Rupture | 6.013E-12 | 1.295E-10 |
| 09 | Poolfire from the release of liquid hydrocarbons | Manual shutdown | Rupture | 5.893E-08 | 1.269E-06 |
| 09 | Poolfire from the release of liquid hydrocarbons | Shutdown failure | Rupture | 5.953E-10 | 1.282E-08 |
| 09 | Poolfire from the release of liquid hydrocarbons | Manual shutdown | Small release | 2.989E-05 | 2.989E-05 |
| 09 | Poolfire from the release of liquid hydrocarbons | Shutdown failure | Small release | 3.020E-07 | 3.020E-07 |
| 10 | Explosion from initialy uniginited release | Manual shutdown | Large release | 3.020E-08 | 1.781E-08 |
| 10 | Explosion from initialy uniginited release | Shutdown failure | Large release | 3.051E-10 | 1.799E-10 |
| 10 | Poolfire from the release of liquid hydrocarbons | Manual shutdown | Large release | 2.990E-06 | 1.763E-06 |
| 10 | Poolfire from the release of liquid hydrocarbons | Shutdown failure | Large release | 3.020E-08 | 1.781E-08 |
| 10 | Explosion from initialy uniginited release | Manual shutdown | Medium release | 2.429E-08 | 2.429E-08 |
| 10 | Explosion from initialy uniginited release | Shutdown failure | Medium release | 2.453E-10 | 2.453E-10 |
| 10 | Poolfire from the release of liquid hydrocarbons | Manual shutdown | Medium release | 2.405E-06 | 2.405E-06 |
| 10 | Poolfire from the release of liquid hydrocarbons | Shutdown failure | Medium release | 2.429E-08 | 2.429E-08 |
| 10 | Explosion from initialy uniginited release | Manual shutdown | Rupture | 0.000E+00 | 1.264E-08 |
| 10 | Explosion from initialy uniginited release | Shutdown failure | Rupture | 0.000E+00 | 1.277E-10 |
| 10 | Poolfire from the release of liquid hydrocarbons | Manual shutdown | Rupture | 0.000E+00 | 1.251E-06 |
| 10 | Poolfire from the release of liquid hydrocarbons | Shutdown failure | Rupture | 0.000E+00 | 1.264E-08 |
| 10 | Poolfire from the release of liquid hydrocarbons | Manual shutdown | Small release | 3.501E-06 | 3.501E-06 |
| 10 | Poolfire from the release of liquid hydrocarbons | Shutdown failure | Small release | 3.536E-08 | 3.536E-08 |
| 11 | Explosion from initialy uniginited release | Manual shutdown | Large release | 1.732E-07 | 1.606E-07 |
| 11 | Explosion from initialy uniginited release | Shutdown failure | Large release | 1.749E-09 | 1.622E-09 |
| 11 | Poolfire from the release of liquid hydrocarbons | Manual shutdown | Large release | 1.714E-05 | 1.590E-05 |
| 11 | Poolfire from the release of liquid hydrocarbons | Shutdown failure | Large release | 1.732E-07 | 1.606E-07 |
| 11 | Poolfire from the release of liquid hydrocarbons | Manual shutdown | Medium release | 9.285E-06 | 9.285E-06 |
| 11 | Poolfire from the release of liquid hydrocarbons | Shutdown failure | Medium release | 9.379E-08 | 9.379E-08 |
| 11 | BLEVE from initially uniginited release | Shutdown failure | Rupture | 8.371E-12 | 1.256E-10 |
| 11 | Explosion from initialy uniginited release | Manual shutdown | Rupture | 8.287E-10 | 1.243E-08 |
| 11 | Explosion from initialy uniginited release | Shutdown failure | Rupture | 8.371E-12 | 1.256E-10 |
| 11 | Poolfire from the release of liquid hydrocarbons | Manual shutdown | Rupture | 8.204E-08 | 1.231E-06 |
| 11 | Poolfire from the release of liquid hydrocarbons | Shutdown failure | Rupture | 8.287E-10 | 1.243E-08 |

| Section | Event | Shutdown Method | Release Size | Frequency | Frequency (Sensitivity analysis) |
|---|---|---|---|---|---|
| 11 | Poolfire from the release of liquid hydrocarbons | Manual shutdown | Small release | 3.888E-06 | 3.888E-06 |
| 11 | Poolfire from the release of liquid hydrocarbons | Shutdown failure | Small release | 3.928E-08 | 3.928E-08 |
| 12 | Explosion from initialy uniginited release | Manual shutdown | Large release | 9.928E-08 | 6.519E-08 |
| 12 | Explosion from initialy uniginited release | Shutdown failure | Large release | 1.003E-09 | 6.584E-10 |
| 12 | Poolfire from the release of liquid hydrocarbons | Manual shutdown | Large release | 9.828E-06 | 6.453E-06 |
| 12 | Poolfire from the release of liquid hydrocarbons | Shutdown failure | Large release | 9.928E-08 | 6.519E-08 |
| 12 | Explosion from initialy uniginited release | Manual shutdown | Medium release | 7.756E-08 | 4.300E-08 |
| 12 | Explosion from initialy uniginited release | Shutdown failure | Medium release | 7.835E-10 | 4.343E-10 |
| 12 | Poolfire from the release of liquid hydrocarbons | Manual shutdown | Medium release | 7.679E-06 | 4.257E-06 |
| 12 | Poolfire from the release of liquid hydrocarbons | Shutdown failure | Medium release | 7.756E-08 | 4.300E-08 |
| 12 | Explosion from initialy uniginited release | Manual shutdown | Rupture | 0.000E+00 | 2.072E-10 |
| 12 | Explosion from initialy uniginited release | Shutdown failure | Rupture | 0.000E+00 | 2.093E-12 |
| 12 | Poolfire from the release of liquid hydrocarbons | Manual shutdown | Rupture | 0.000E+00 | 2.051E-08 |
| 12 | Poolfire from the release of liquid hydrocarbons | Shutdown failure | Rupture | 0.000E+00 | 2.072E-10 |
| 12 | Poolfire from the release of liquid hydrocarbons | Manual shutdown | Small release | 1.056E-05 | 4.220E-06 |
| 12 | Poolfire from the release of liquid hydrocarbons | Shutdown failure | Small release | 1.067E-07 | 4.262E-08 |
| 13 | Explosion from initialy uniginited release | Manual shutdown | Large release | 9.895E-08 | 8.648E-08 |
| 13 | Explosion from initialy uniginited release | Shutdown failure | Large release | 9.995E-10 | 8.735E-10 |
| 13 | Poolfire from the release of liquid hydrocarbons | Manual shutdown | Large release | 9.796E-06 | 8.562E-06 |
| 13 | Poolfire from the release of liquid hydrocarbons | Shutdown failure | Large release | 9.895E-08 | 8.648E-08 |
| 13 | Explosion from initialy uniginited release | Manual shutdown | Medium release | 5.623E-08 | 5.623E-08 |
| 13 | Explosion from initialy uniginited release | Shutdown failure | Medium release | 5.680E-10 | 5.680E-10 |
| 13 | Poolfire from the release of liquid hydrocarbons | Manual shutdown | Medium release | 5.567E-06 | 5.567E-06 |
| 13 | Poolfire from the release of liquid hydrocarbons | Shutdown failure | Medium release | 5.623E-08 | 5.623E-08 |
| 13 | Explosion from initialy uniginited release | Manual shutdown | Rupture | 2.072E-10 | 1.243E-08 |
| 13 | Explosion from initialy uniginited release | Shutdown failure | Rupture | 2.093E-12 | 1.256E-10 |
| 13 | Poolfire from the release of liquid hydrocarbons | Manual shutdown | Rupture | 2.051E-08 | 1.231E-06 |
| 13 | Poolfire from the release of liquid hydrocarbons | Shutdown failure | Rupture | 2.072E-10 | 1.243E-08 |
| 13 | Poolfire from the release of liquid hydrocarbons | Manual shutdown | Small release | 2.372E-06 | 2.372E-06 |
| 13 | Poolfire from the release of liquid hydrocarbons | Shutdown failure | Small release | 2.396E-08 | 2.396E-08 |

| Section | Event | Shutdown Method | Release Size | Frequency | Frequency (Sensitivity analysis) |
|---|---|---|---|---|---|
| 14 | Explosion from initialy uniginited release | Manual shutdown | Large release | 1.668E-08 | 2.650E-08 |
| 14 | Explosion from initialy uniginited release | Shutdown failure | Large release | 1.685E-10 | 2.676E-10 |
| 14 | Poolfire from the release of liquid hydrocarbons | Manual shutdown | Large release | 1.652E-06 | 2.623E-06 |
| 14 | Poolfire from the release of liquid hydrocarbons | Shutdown failure | Large release | 1.668E-08 | 2.650E-08 |
| 14 | Explosion from initialy uniginited release | Manual shutdown | Medium release | 8.782E-09 | 2.312E-08 |
| 14 | Explosion from initialy uniginited release | Shutdown failure | Medium release | 8.871E-11 | 2.335E-10 |
| 14 | Poolfire from the release of liquid hydrocarbons | Manual shutdown | Medium release | 8.694E-07 | 2.289E-06 |
| 14 | Poolfire from the release of liquid hydrocarbons | Shutdown failure | Medium release | 8.782E-09 | 2.312E-08 |
| 14 | Explosion from initialy uniginited release | Manual shutdown | Rupture | 0.000E+00 | 2.072E-10 |
| 14 | Explosion from initialy uniginited release | Shutdown failure | Rupture | 0.000E+00 | 2.093E-12 |
| 14 | Poolfire from the release of liquid hydrocarbons | Manual shutdown | Rupture | 0.000E+00 | 2.051E-08 |
| 14 | Poolfire from the release of liquid hydrocarbons | Shutdown failure | Rupture | 0.000E+00 | 2.072E-10 |
| 14 | Poolfire from the release of liquid hydrocarbons | Manual shutdown | Small release | 3.618E-07 | 3.434E-06 |
| 14 | Poolfire from the release of liquid hydrocarbons | Shutdown failure | Small release | 3.654E-09 | 3.469E-08 |
| 15 | Explosion from initialy uniginited release | Manual shutdown | Large release | 1.519E-08 | 2.761E-09 |
| 15 | Explosion from initialy uniginited release | Shutdown failure | Large release | 1.535E-10 | 2.789E-11 |
| 15 | Poolfire from the release of liquid hydrocarbons | Manual shutdown | Large release | 1.504E-06 | 2.734E-07 |
| 15 | Poolfire from the release of liquid hydrocarbons | Shutdown failure | Large release | 1.519E-08 | 2.761E-09 |
| 15 | Explosion from initialy uniginited release | Manual shutdown | Medium release | 6.175E-09 | 6.175E-09 |
| 15 | Explosion from initialy uniginited release | Shutdown failure | Medium release | 6.238E-11 | 6.238E-11 |
| 15 | Poolfire from the release of liquid hydrocarbons | Manual shutdown | Medium release | 6.113E-07 | 6.113E-07 |
| 15 | Poolfire from the release of liquid hydrocarbons | Shutdown failure | Medium release | 6.175E-09 | 6.175E-09 |
| 15 | Explosion from initialy uniginited release | Manual shutdown | Rupture | 0.000E+00 | 1.243E-08 |
| 15 | Explosion from initialy uniginited release | Shutdown failure | Rupture | 0.000E+00 | 1.256E-10 |
| 15 | Poolfire from the release of liquid hydrocarbons | Manual shutdown | Rupture | 0.000E+00 | 1.231E-06 |
| 15 | Poolfire from the release of liquid hydrocarbons | Shutdown failure | Rupture | 0.000E+00 | 1.243E-08 |
| 15 | Poolfire from the release of liquid hydrocarbons | Manual shutdown | Small release | 3.540E-07 | 3.540E-07 |
| 15 | Poolfire from the release of liquid hydrocarbons | Shutdown failure | Small release | 3.576E-09 | 3.576E-09 |
| 16 | Explosion from initialy uniginited release | Manual shutdown | Large release | 2.768E-08 | 1.525E-08 |
| 16 | Explosion from initialy uniginited release | Shutdown failure | Large release | 2.796E-10 | 1.540E-10 |

| Section | Event | Shutdown Method | Release Size | Frequency | Frequency (Sensitivity analysis) |
|---|---|---|---|---|---|
| 16 | Poolfire from the release of liquid hydrocarbons | Manual shutdown | Large release | 2.740E-06 | 1.510E-06 |
| 16 | Poolfire from the release of liquid hydrocarbons | Shutdown failure | Large release | 2.768E-08 | 1.525E-08 |
| 16 | Explosion from initialy uniginited release | Manual shutdown | Medium release | 1.055E-08 | 1.055E-08 |
| 16 | Explosion from initialy uniginited release | Shutdown failure | Medium release | 1.065E-10 | 1.065E-10 |
| 16 | Poolfire from the release of liquid hydrocarbons | Manual shutdown | Medium release | 1.044E-06 | 1.044E-06 |
| 16 | Poolfire from the release of liquid hydrocarbons | Shutdown failure | Medium release | 1.055E-08 | 1.055E-08 |
| 16 | BLEVE from initially uniginited release | Manual shutdown | Rupture | 0.000E+00 | 1.243E-08 |
| 16 | BLEVE from initially uniginited release | Shutdown failure | Rupture | 0.000E+00 | 1.256E-10 |
| 16 | Explosion from initialy uniginited release | Manual shutdown | Rupture | 0.000E+00 | 1.243E-08 |
| 16 | Explosion from initialy uniginited release | Shutdown failure | Rupture | 0.000E+00 | 1.256E-10 |
| 16 | Poolfire from the release of liquid hydrocarbons | Manual shutdown | Rupture | 0.000E+00 | 1.231E-06 |
| 16 | Poolfire from the release of liquid hydrocarbons | Shutdown failure | Rupture | 0.000E+00 | 1.243E-08 |
| 16 | Poolfire from the release of liquid hydrocarbons | Manual shutdown | Small release | 6.048E-07 | 6.048E-07 |
| 16 | Poolfire from the release of liquid hydrocarbons | Shutdown failure | Small release | 6.109E-09 | 6.109E-09 |
| 17 | Poolfire from the release of liquid hydrocarbons | Manual shutdown | Large release | 2.771E-06 | 1.540E-06 |
| 17 | Poolfire from the release of liquid hydrocarbons | Shutdown failure | Large release | 2.799E-08 | 1.556E-08 |
| 17 | Poolfire from the release of liquid hydrocarbons | Manual shutdown | Medium release | 2.843E-06 | 2.843E-06 |
| 17 | Poolfire from the release of liquid hydrocarbons | Shutdown failure | Medium release | 2.871E-08 | 2.871E-08 |
| 17 | Poolfire from the release of liquid hydrocarbons | Manual shutdown | Rupture | 2.051E-08 | 1.251E-06 |
| 17 | Poolfire from the release of liquid hydrocarbons | Shutdown failure | Rupture | 2.072E-10 | 1.264E-08 |
| 17 | Poolfire from the release of liquid hydrocarbons | Manual shutdown | Small release | 6.148E-06 | 6.148E-06 |
| 17 | Poolfire from the release of liquid hydrocarbons | Shutdown failure | Small release | 6.210E-08 | 6.210E-08 |
| 18 | Explosion (from export pipe release while idle) | Manual shutdown | Large release | 9.447E-08 | 9.447E-08 |
| 18 | Explosion (from export pipe release while idle) | Shutdown failure | Large release | 9.543E-10 | 9.543E-10 |
| 18 | Explosion (from export pipe release while operating) | Manual shutdown | Large release | 9.447E-08 | 9.447E-08 |
| 18 | Explosion (from export pipe release while operating) | Shutdown failure | Large release | 9.543E-10 | 9.543E-10 |
| 18 | Poolfire (from export pipe release while idle) | Manual shutdown | Large release | 9.353E-06 | 9.353E-06 |
| 18 | Poolfire (from export pipe release while idle) | Shutdown failure | Large release | 9.447E-08 | 9.447E-08 |
| 18 | Poolfire (from export pipe release while operating) | Manual shutdown | Large release | 9.353E-06 | 9.353E-06 |

| Section | Event | Shutdown Method | Release Size | Frequency | Frequency (Sensitivity analysis) |
|---|---|---|---|---|---|
| 18 | Poolfire (from export pipe release while operating) | Shutdown failure | Large release | 9.447E-08 | 9.447E-08 |
| 18 | Explosion (from export pipe release while idle) | Manual shutdown | Medium release | 4.435E-08 | 4.435E-08 |
| 18 | Explosion (from export pipe release while idle) | Shutdown failure | Medium release | 4.479E-10 | 4.479E-10 |
| 18 | Explosion (from export pipe release while operating) | Manual shutdown | Medium release | 4.435E-08 | 4.435E-08 |
| 18 | Explosion (from export pipe release while operating) | Shutdown failure | Medium release | 4.479E-10 | 4.479E-10 |
| 18 | Poolfire (from export pipe release while idle) | Manual shutdown | Medium release | 4.390E-06 | 4.390E-06 |
| 18 | Poolfire (from export pipe release while idle) | Shutdown failure | Medium release | 4.435E-08 | 4.435E-08 |
| 18 | Poolfire (from export pipe release while operating) | Manual shutdown | Medium release | 4.390E-06 | 4.390E-06 |
| 18 | Poolfire (from export pipe release while operating) | Shutdown failure | Medium release | 4.435E-08 | 4.435E-08 |
| 18 | Explosion (from export pipe release while idle) | Manual shutdown | Rupture | 1.313E-08 | 1.313E-08 |
| 18 | Explosion (from export pipe release while idle) | Shutdown failure | Rupture | 1.326E-10 | 1.326E-10 |
| 18 | Explosion (from export pipe release while operating) | Manual shutdown | Rupture | 1.313E-08 | 1.313E-08 |
| 18 | Explosion (from export pipe release while operating) | Shutdown failure | Rupture | 1.326E-10 | 1.326E-10 |
| 18 | Poolfire (from export pipe release while idle) | Manual shutdown | Rupture | 1.300E-06 | 1.300E-06 |
| 18 | Poolfire (from export pipe release while idle) | Shutdown failure | Rupture | 1.313E-08 | 1.313E-08 |
| 18 | Poolfire (from export pipe release while operating) | Manual shutdown | Rupture | 1.300E-06 | 1.300E-06 |
| 18 | Poolfire (from export pipe release while operating) | Shutdown failure | Rupture | 1.313E-08 | 1.313E-08 |
| 18 | Poolfire (from export pipe release while idle) | Manual shutdown | Small release | 6.848E-06 | 6.848E-06 |
| 18 | Poolfire (from export pipe release while idle) | Shutdown failure | Small release | 6.917E-08 | 6.917E-08 |
| 18 | Poolfire (from export pipe release while operating) | Manual shutdown | Small release | 6.848E-06 | 6.848E-06 |
| 18 | Poolfire (from export pipe release while operating) | Shutdown failure | Small release | 6.917E-08 | 6.917E-08 |