

Primavera Risk Analysis - Weather Modeling

Weather Modeling

This document is an extract from the Primavera Risk Analysis help file version 8.7 SP5.

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1	Weather Modeling	

1.1 Weather Modeling Overview

Weather can be a significant factor in a project schedule.

Very often there is good data for estimating weather conditions, but it is difficult to understand the effect it can have on a schedule. This is particularly true when the schedule is subject to other risks, because the timing of individual tasks is then unknown. Because weather varies seasonally, it is therefore difficult to know which tasks will be affected by it and by how much.

The Weather Modeling module for Primavera Risk Analysis allows you to define risk assessments for weather conditions in any plan, and include these uncertain weather conditions in the risk analysis. The risk analysis will correctly combine the timing of the weather risks with the timing of the tasks that are affected by other risks and uncertainty.

Risk due to weather causes tasks to be interrupted or delayed by "downtime", or non-working periods.

Weather Events

Weather Events are weather conditions that result in scattered blocks of down-time.

There are two distinct ways of defining weather events:

1. A Weather Event with a probability of 100% results in an uncertain number of non-working days (defined as a 3 point estimate) scattered throughout a period, e.g. days lost in a period due to poor weather.
2. A Weather Event with a probability of less than 100% results in a single block of non-working time with a probability of occurrence, e.g. chance of a hurricane in a period. When the weather event occurs the amount of non-working time can also have a uncertain duration defined as a 3 point estimate.

The probabilities and 3 point estimates can be varied over time, so that seasonal variations in the likelihood and impact of these weather events can be reflected in the risk analysis.

Weather Windows

Weather Windows are weather conditions that result uncertainty in the periods of down-time, e.g. uncertainty in the date a canal freezes over and thaws. You specify the uncertainty in when the non-working periods could start and finish (as 3 point estimates).

Examples

- **Hurricanes (Section 1.2)** - Uses a Weather Event calendar with probabilities less than 100% to represent hurricane risk.
- **Drilling Days Lost to Weather (Section 1.3)** - Uses a Weather Event calendars with probabilities of 100% to represent drilling days lost that vary regionally.
- **Seasonal Weather Windows (Section 1.4)** - Uses a Weather Windows calendar to represent uncertain seasonal winter freezing of a canal.

1.2 Weather Modeling Example - Hurricanes

- *Help | Open Samples | ExampleWeatherMod-Hurricanes.plan*

In this project, offshore activities are affected by hurricanes. Hurricanes have a different probability of occurrence, and they disrupt work for a different amount of time, depending on the time of year.

Part of the risk assessment for this project has included a hurricane risk assessment. For each month of the year, the project team has assessed the chance of a hurricane and how long it could last.

For example in June 2009 there is a 10% chance of a hurricane, and if it happens it would last between 3 and 4 days. This assessment is represented with in the following weather events calendar:

Weather Events		Weather Windows		
Existing Weather Event Calendars		<div> <div>Add New Event Calendar...</div> <div>Delete Event Calendar</div> </div> <div>HURRICANE</div> <div>Use weather eve between two dat</div> <div>Enter a Probabilit probabilistic non- hurricane.</div>		
Period Description	Start	Finish	Probability of Occurrence	Minimum
June	01/Jun/2007	01/Jul/2007	10%	3
July	01/Jul/2007	01/Aug/2007	30%	3
August	01/Aug/2007	01/Sep/2007	80%	4
September	01/Sep/2007	01/Oct/2007	90%	5
October	01/Oct/2007	01/Nov/2007	90%	5
November	01/Nov/2007	01/Dec/2007	70%	3
December	01/Dec/2007	01/Jan/2008	5%	3
June	01/Jun/2008	01/Jul/2008	10%	3
July	01/Jul/2008	01/Aug/2008	30%	3
August	01/Aug/2008	01/Sep/2008	80%	4
September	01/Sep/2008	01/Oct/2008	90%	5
October	01/Oct/2008	01/Nov/2008	90%	5
November	01/Nov/2008	01/Dec/2008	70%	3
December	01/Dec/2008	01/Jan/2009	5%	3
June	01/Jun/2009	01/Jul/2009	10%	3
July	01/Jul/2009	01/Aug/2009	30%	3
August	01/Aug/2009	01/Sep/2009	80%	4
September	01/Sep/2009	01/Oct/2009	90%	5
October	01/Oct/2009	01/Nov/2009	90%	5
November	01/Nov/2009	01/Dec/2009	70%	3
December	01/Dec/2009	01/Jan/2010	5%	3

During the risk analysis, those tasks which are affected by hurricanes will lose blocks of days from randomly sampled hurricanes. The extent and probability will depend according to when the tasks occur, and are different in each iteration:

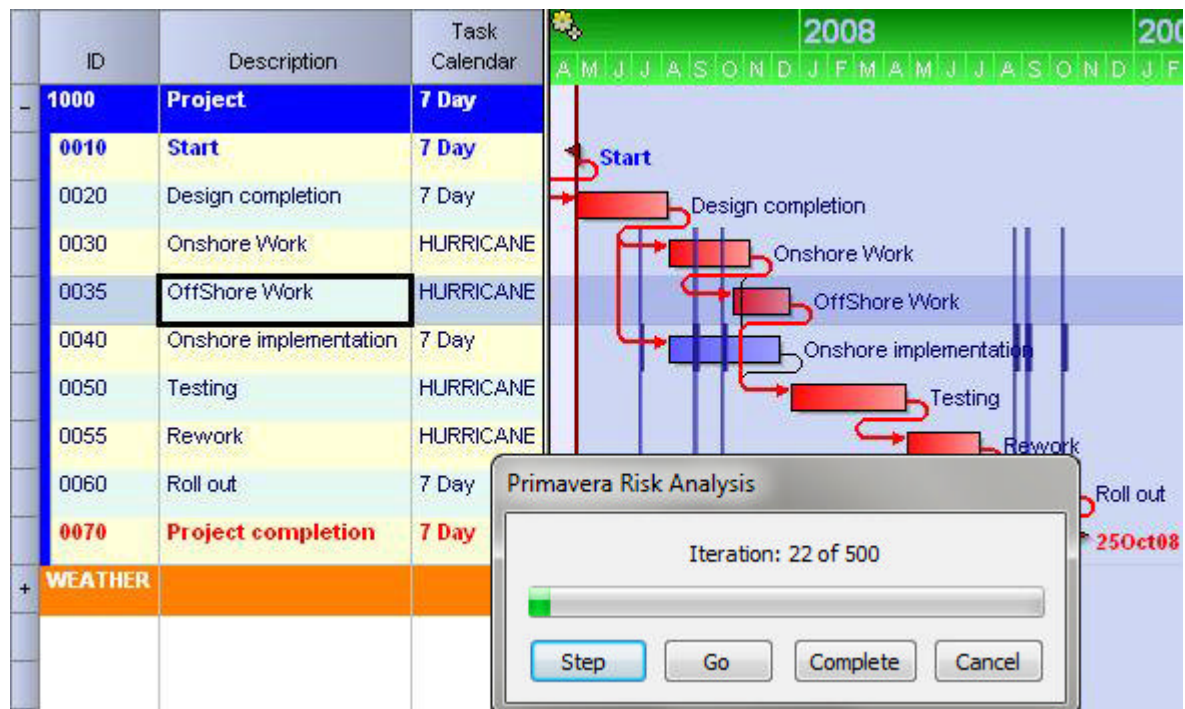


Figure: Notice how there is no hurricane in July 2008. The weather risk assessment says that it can occur; it just happens to have not occurred in the iteration shown in this picture.

1.3 Weather Modeling Example - Drilling Days Lost to Weather

- *Help | Open Samples | ExampleWeatherMod-DrillingDaysLost.plan*

This drilling project is certain to be affected by weather. The number of drilling days lost due to weather varies throughout the year, and also throughout the geographical regions.

The risk of losing drilling days due to weather has been assessed as part of the project's risk assessment. For each month of the year, each region's team has estimated how many drilling days (as a three-point estimate) will be lost due to weather.

For example, in the Shetland area, the number of days lost in September is estimated to be between 5 and 8 days (most likely 6). Each region's assessment is represented by this weather events calendar:

Weather Events Weather Windows

Existing Weather Event Calendars

Add New Event Calendar...

Delete Event Calendar

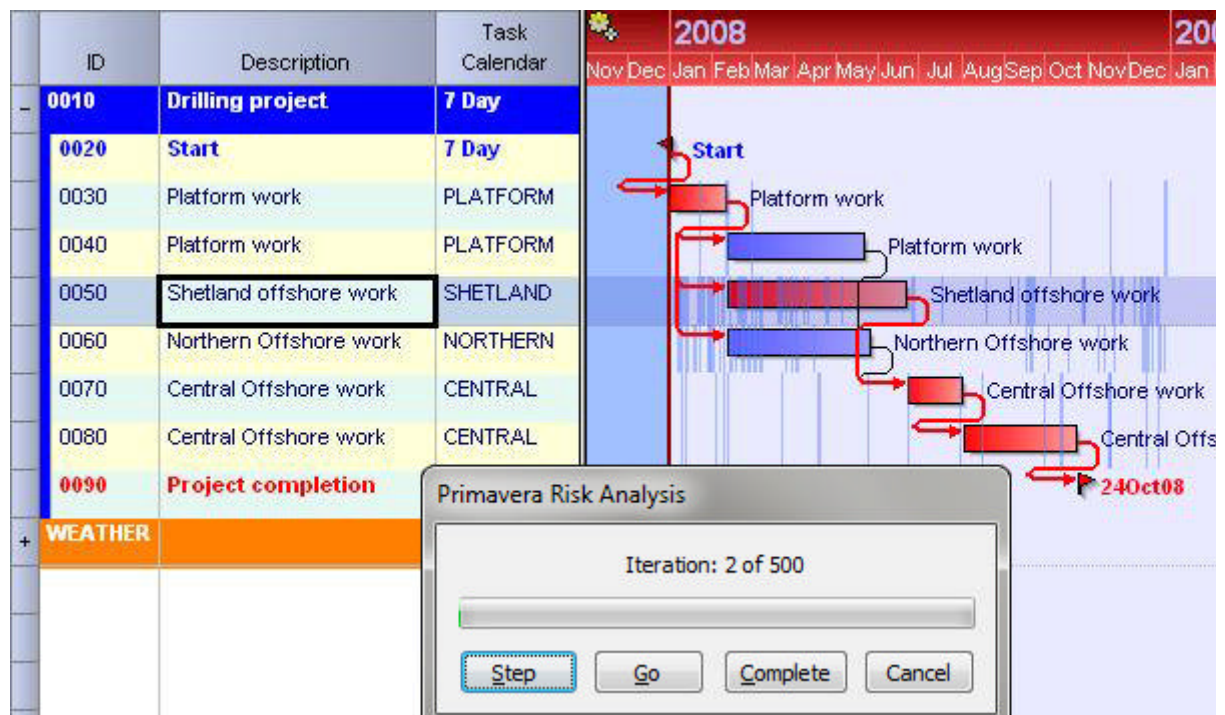
SHETLAND
CENTRAL
NORTHERN
PLATFORM

Use weather event between two dates.

Enter a Probabilistic non hurricane.

Period Description	Start	Finish	Probability of Occurrence	Minimum
January	01/Jan/2008	01/Feb/2008	100%	12
February	01/Feb/2008	01/Mar/2008	100%	10
March	01/Mar/2008	01/Apr/2008	100%	10
April	01/Apr/2008	01/May/2008	100%	2
May	01/May/2008	01/Jun/2008	100%	1
June	01/Jun/2008	01/Jul/2008	100%	1
July	01/Jul/2008	01/Aug/2008	100%	1
August	01/Aug/2008	01/Sep/2008	100%	1
September	01/Sep/2008	01/Oct/2008	100%	5
October	01/Oct/2008	01/Nov/2008	100%	2
November	01/Nov/2008	01/Dec/2008	100%	2
December	01/Dec/2008	01/Jan/2009	100%	7

Tasks in offshore regions are extended by the weather, differently in each iteration:



The blue vertical lines in this picture show the non-working time extending the task. The highlighted task is affected according to the weather risk assessment data for the Shetland period. Notice how the tasks that use the "platform" calendar are affected by much less severe weather conditions.

Naturally the model is also simulating the existence and severity of other risks from the risk assessment, and over the entire simulation it accurately combines the effect of these with the weather risk.

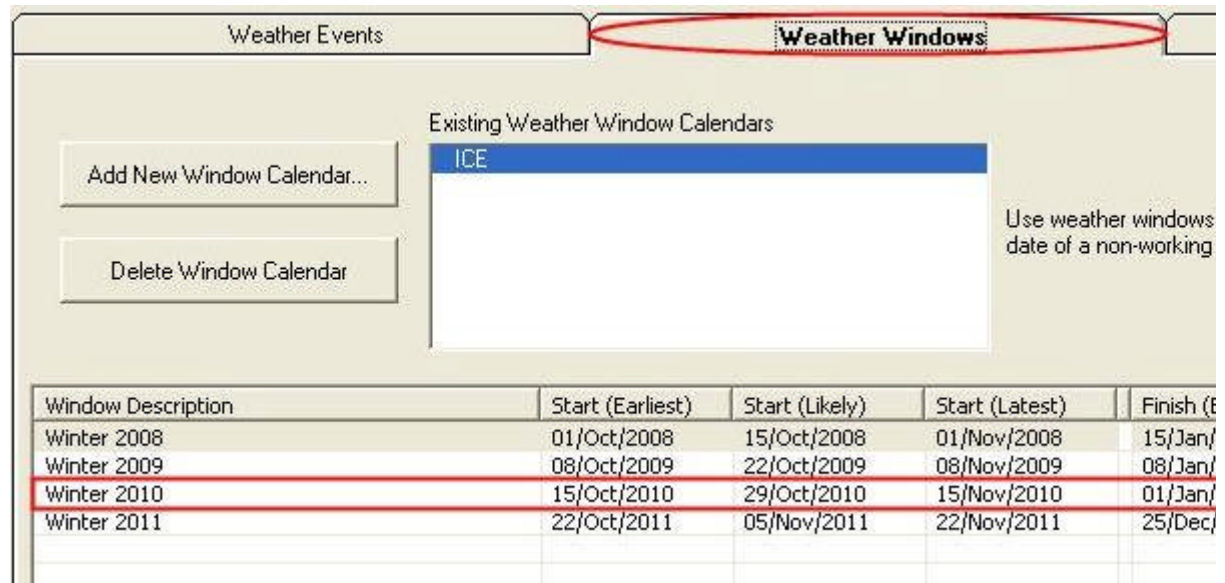
1.4 Weather Modeling Example - Seasonal Weather Windows

- *Help | Open Samples | ExampleWeatherMod-IceDrilling.plan*

In this project a series of activities will be interrupted by freezing winters. The date that winter sets in, and the date it thaws, is unreliable and are known to vary from one year to the next.

The risk assessment includes three-point estimates of the dates that winter starts and finishes each year.

For example, in 2010 the winter is predicted to start between 15 October and 15 November. The winters are represented by a weather windows calendar.



The winter periods interrupt the tasks, according to the estimates of the start and finish dates:

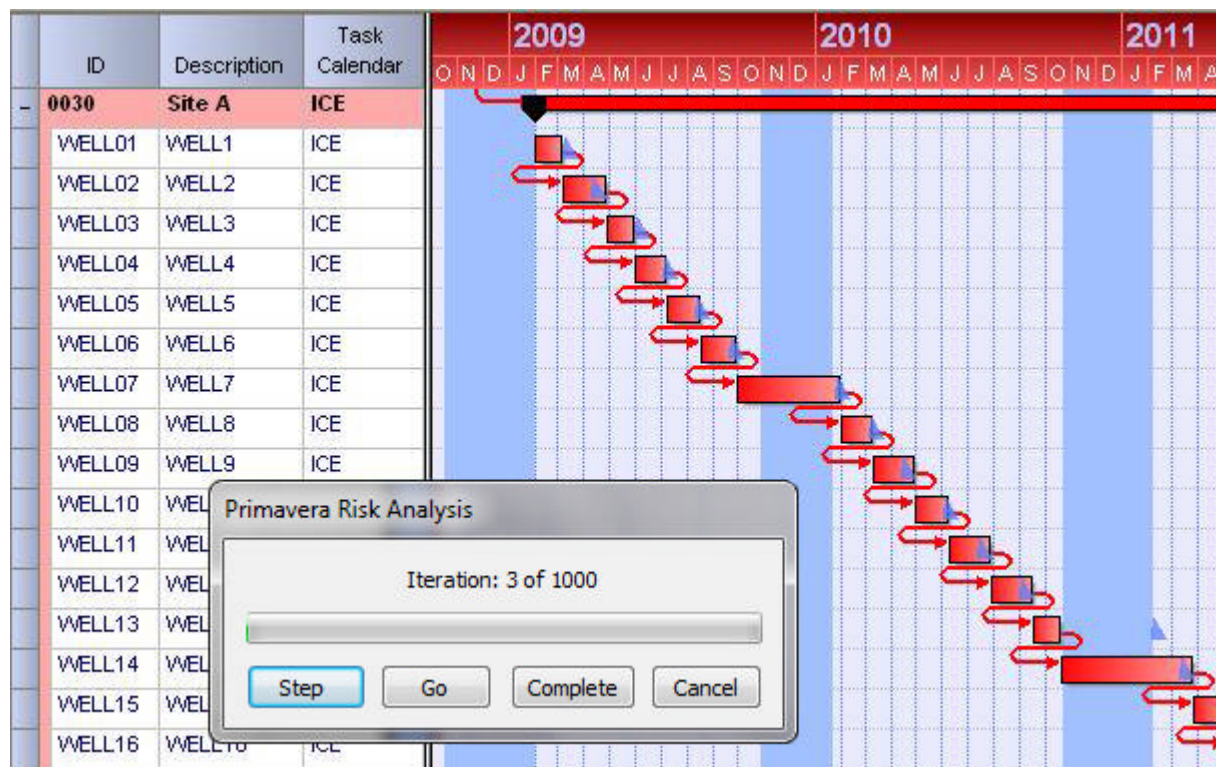



Figure: This picture shows how the winter period is sampled differently in each year. In this iteration,

the 2009/10 winter ends in mid-January, but the winter next year lasts until the beginning of February.

 In this plan, the activities are interrupted by the winter period – work can begin in one season and finish in another. Tasks can easily be made "un-interruptible", where they cannot be split across a non-working period. For more information, see **Preventing a task from splitting across non-working time (Section 1.8)**.

1.5 Weather Modeling - Creating Weather Calendars

A weather calendar is a definition of the risk of non-working days. It specifies a given set of probabilities, durations and dates of down-time that varies over the seasons. You would use one weather calendar for each region, for example, or to represent one particular kind of threat.

You can add a weather calendar to any plan:

1. Open any plan in Primavera Risk Analysis.
2. *Risk | Weather Modeling*.
3. Tick the *Add weather modeling to this plan* option.
4. Decide whether you want to add a weather events calendar or a weather windows calendar. For a description of the difference between the types of calendar, see **Weather Modeling Overview (Section 1.1)**. The **Hurricane Example (Section 1.2)** and **Drilling Days Lost to Weather (Section 1.3)** both use weather events calendars, whereas **Seasonal Weather Windows example (Section 1.4)** example uses a weather windows calendar.
5. Choose the *Weather Events* or *Weather Windows* tab accordingly.


For a Weather Event calendar:


1. On the *Weather Events* tab, choose *Add New Event Calendar*.
2. Type the name of the new Weather Events calendar, choose the range monthly periods you want the calendar to cover, and choose *OK*.
3. Either: Keep the *Probability of Occurrence* as 100% to model an uncertain number of non-working days scattered throughout a period, e.g. days lost in a period due to poor weather.
4. Or: Change to *Probability of Occurrence* to a value less than 100% to model a single block of non-working time with a probability of occurrence, e.g. chance of a hurricane in a period.
5. Assign minimum, most likely and maximum downtime duration for each period at the bottom of the dialog.
6. Add more periods using the *Add New Period(s) to Calendar* button.

For a Weather Window calendar:

1. On the *Weather Windows* tab, choose *Add New Window Calendar*.
2. Type the name of the new weather windows calendar, and choose *OK*.
3. Click on the default period, and define its start and finish dates as three-point estimates at the bottom of the dialog.
4. Add more periods using the *Add Window to Calendar* button.



Once you have set up the weather calendar, you need to define which tasks in the project are affected by it - see **Assigning weather calendars to tasks (Section 1.6)**.

 You can easily extend a calendar to cover more periods – see **Importing and Exporting data (Section 1.9)**.

 You cannot specify deterministic working and non-working periods for a weather calendar.



1.6 Weather Modeling - Assigning weather calendars to tasks

Once you have added weather calendars to a plan, you need to define which tasks are affected by them. You do this by assigning the weather calendars to the tasks:

1. *Risk | Weather Modeling.*
2. Choose the *Assign to Tasks* tab.
3. On the left-hand side, choose a task which is affected by weather.
 You can search for a task by typing some text and using the Find button.
4. On the right-hand side, choose which task calendar affects the task.
5. Choose which of the Weather **Events** affect the task by ticking them in the *Weather Event Calendars* section.
6. Choose which of the Weather **Windows** affect the task by ticking them in the *Weather Window Calendars* section.
 A task can be affected by more than one weather calendar, in any combination.
7. Repeat this process to assign the weather risk to the other tasks.
8. Choose *Close*.

1.7 Weather Modeling - Running Risk Analysis

Once you have set up the weather calendars, and assigned them to the tasks in the plan, you can test and run the analysis as normal:

1. *Risk | Run Risk Analysis | Analyze | Step.*
2. Press *Step* repeatedly to examine how the weather affects each task.
 The downtime due to the weather usually shows as blue vertical lines on the Gantt chart. It will show differently as it is randomly sampled in each iteration of the analysis.
3. Press *Complete* to finish the analysis as quickly as possible, and view the risk results as normal.
 All the results will include the effect of the weather risk.


You will see that the weather risk combines with the other risk assessments in the plan – as tasks are delayed and affected by risks in the risk register, and uncertainty in their durations, they will then be further affected by the weather according to their timing.

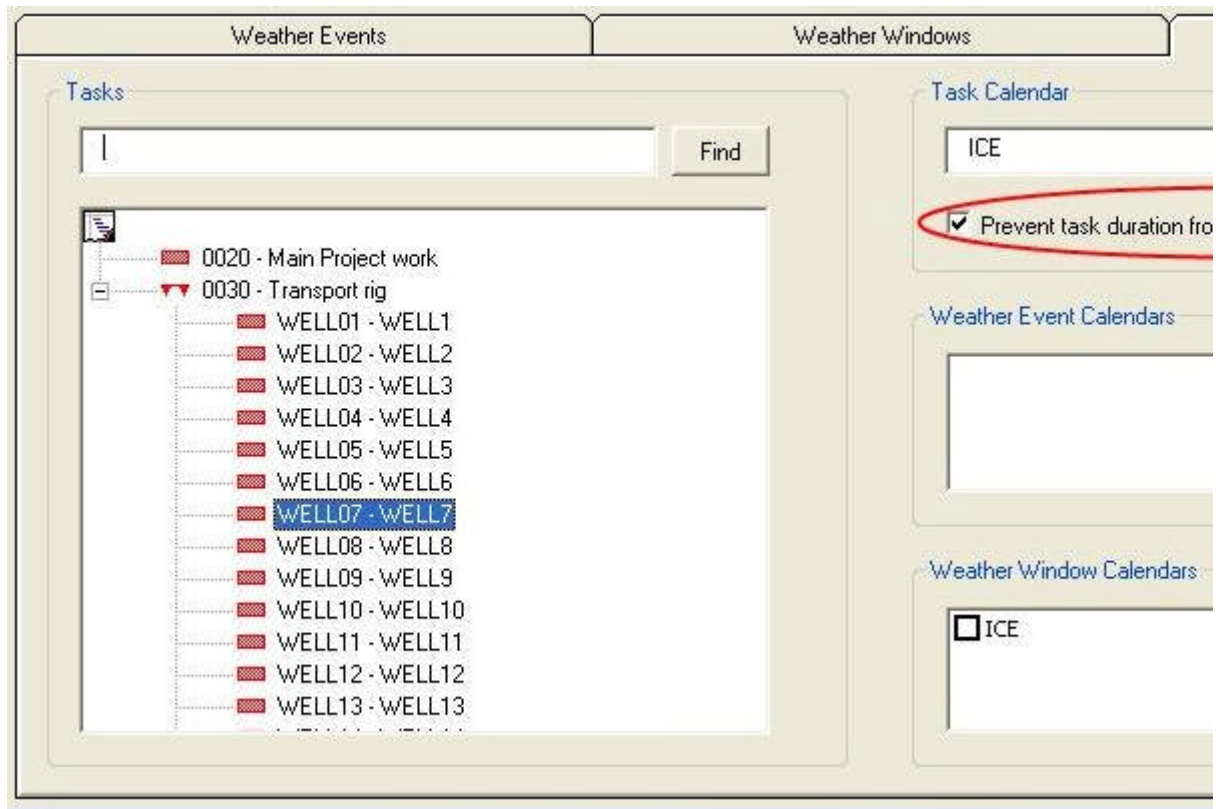
1.8 Weather Modeling - Preventing a task from splitting across non-working time

When a task in Primavera Risk Analysis has non-working time, it will be interrupted by the down-time. When the down-time is a long period, such as an entire winter season, you might want the task to be delayed until the next season rather than be interrupted by the winter.

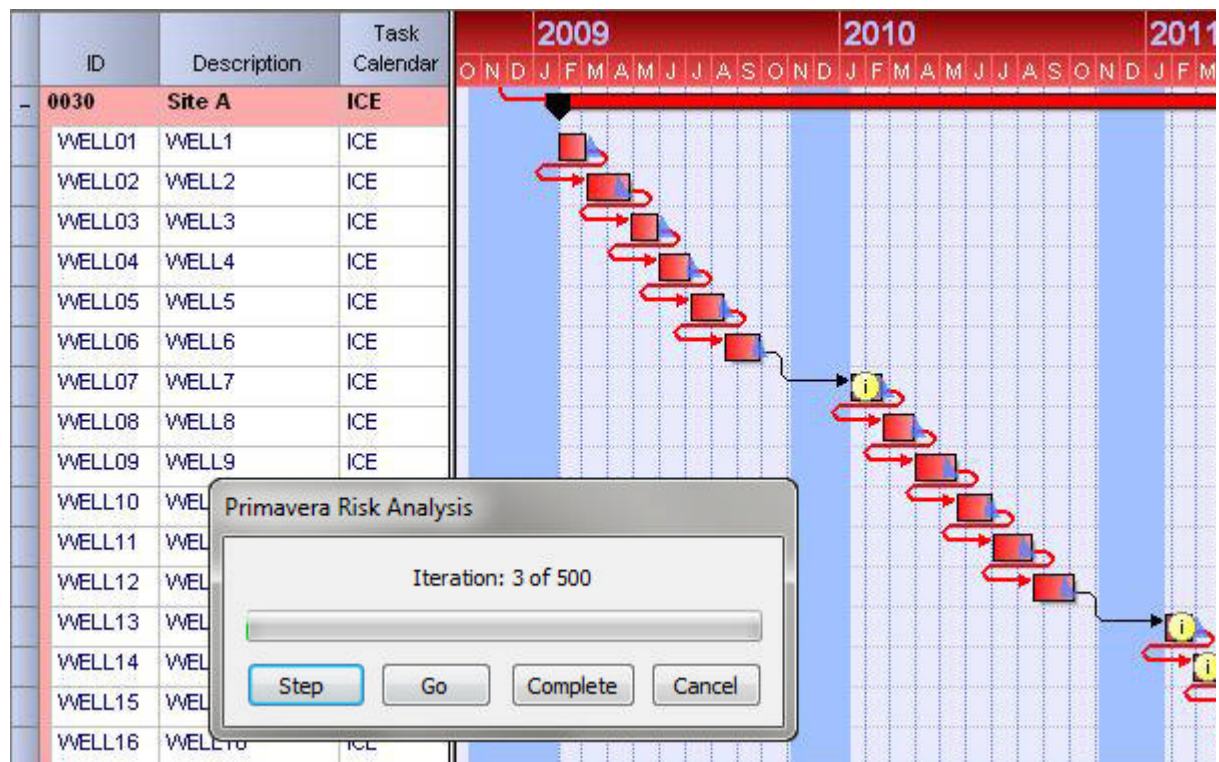
You can specify that any task is delayed rather than interrupted by its calendar. You can do this for any task, even if its calendar is an ordinary Primavera Risk Analysis calendar rather than a weather calendar:

1. *Risk | Weather Modeling* and tick the *Add weather modeling to this plan* option if it is not already ticked.
2. Choose the *Assign to Tasks* tab.
3. In the Tasks window, choose the task you want to be delayed rather than interrupted.
4. Tick the *Prevent task duration from splitting across its task calendar*.

 The change will only apply to the task's calendar, and not the additional weather calendars associated with the task.



During the risk analysis, the task will not start in one working period and finish in another – instead it will be delayed so that it is not interrupted:



1.9 Weather Modeling - Importing and Exporting data

Weather data can be exported and imported from MS Excel.

1. Open an existing plan that contains weather calendars. For example *Help | Open Samples...* and choose the *ExampleWeatherMod-Hurricanes.plan* sample for weather events or the *ExampleWeatherMod-IceDrilling.plan* sample for weather windows.
2. *Risk | Weather Modeling*
3. Choose *Export All Weather Data*. This will create an Excel spreadsheet that contains the weather data from the model.
4. Replace the data with your own, and save the spreadsheet.



You can change the names of the calendars themselves by changing the name of the worksheets that represent them.

5. Return to Primavera Risk Analysis and choose *Import All Weather Data*.
6. Browse for the spreadsheet you saved.

You can extend and edit a plan's weather data in Excel. This means you can take advantage of Excel's "fill" functionality, which can automatically increase the range of a calendar while following the same pattern. To do this:

1. Export the plan's weather data into Excel, as described above.
2. Once you have the weather tables in Excel, you can increase their range by selecting a table, and dragging downwards on the small handle on the bottom right corner of the selection box.
3. Once you have edited and saved the weather data, import it back into the Primavera Risk Analysis plan again using the *Import All Weather Data* button.

You can also prepare data in Excel for an individual weather calendar in this way, and import it into the individual weather calendar in the Primavera Risk Analysis plan. To do this:

1. Prepare a table of weather data on a worksheet in Excel as described above.
2. Choose *Risk | Weather Modeling* in the plan and click on the weather events or weather windows calendar, and then use either the *Import Event Period Data* (for weather events) or the *Import Window Data* (for weather windows) button.
3. A dialog will allow you to choose which sheet of the Excel workbook contains the weather data you want to import.

1.10 Weather Modeling - Advanced details

How weather calendars are maintained

Once you have defined weather calendars using *Risk | Weather Modeling*, each weather calendar is assigned to a task via a resource with the weather calendar. The resource is given the same name as the weather calendar. Use *Plan | Resources* to see these weather resources.

A weather resource has no cost, but does use a particular calendar (also with the same name). Use *Plan | Calendars* to see these. The calendar is defined as having no non-working time deterministically. The non-working time is added to the calendar on each iteration of the risk analysis, as detailed below.

Tasks are assigned the resources according to how they are mapped on the Assign to Tasks tab of the *Risk | Weather Modeling* dialog. To see the assignments, click on a task and use the *Resources* tab of the *Task Details* dialog.

Because a task can only work on those days that all its resources can work, it will be affected by all the weather calendars assigned to it.

How the weather calendars are sampled during the risk analysis

During the iterations, the non-working periods are sampled according to the assessments of their dates, probabilities and durations. You can see them graphically as vertical lines on the Gantt chart when you are stepping through the risk analysis (*Risk | Run Risk Analysis | Analyze | Step*).

Specifically, in each iteration, each weather resource's calendar is sampled according to the weather data as follows:

- For weather events calendars: In each period, Primavera Risk Analysis chooses whether the event occurs, when it occurs within the period, and how long it is.
- For weather windows calendars: For each window, Primavera Risk Analysis chooses the start and

finish dates of the window.

- Any task marked as *Prevent task duration from splitting across its task calendar* (located on the *Assign to Tasks* tab of the *Risk | Weather Modeling* dialog) is checked to see whether the task starts before the weather window and finishes after it. If a task is scheduled across the weather window a constraint date is set to delay the task start to after the weather window. In any iteration, you can see the constraint date (Nudge date) on the *Constraints* tab of the *Task Details* dialog.

1.11 PDF Documentation and Printing Help

PDF Documentation

Some of the on-line help (e.g. tutorials) can be found in the *Documentation* folder that is created when the Primavera Risk Analysis software is installed. The documentation is saved in the Adobe PDF format.

The default installation folder for the documentation is:

C:\Program Files\Oracle\Primavera Risk Analysis\Documentation

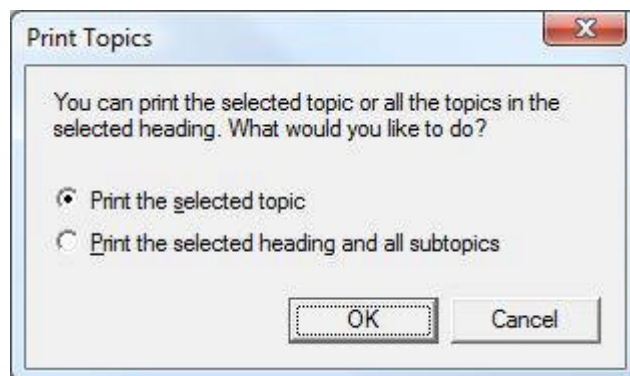
Printing an individual help topic

- After printing a help topic, Windows can sometimes freeze the help file. If this occurs, right-click on the Primavera Risk Analysis help application icon in Windows Start menu Taskbar (usually located at the bottom of the screen) and choose *Restore*.

1. Select the required topic.
2. Click on the *Print* button.



3. Choose *Print the selected topic*.



Printing a chapter of the help

- After printing a chapter of the help, Windows can sometimes freeze the help file. If this occurs right-click on the Primavera Risk Analysis help application icon in Windows Start menu Taskbar (usually located at the bottom of the screen) and choose *Restore*.

1. Select the required chapter.
2. Click on the *Print* button
3. Choose *Print the selected heading and all the subtopics*.

The example below has the Risk Tutorial - Part 1 selected. Clicking on the *Print* button and selecting *Print the selected heading and all the subtopics* will print out the whole of the 'Risk Tutorial - Part 1'.

