
16 CALCULATIONS: OBSTRUCTION MANAGER

16.1 INTRODUCTION

The Obstruction Manager tool enables the user to analyse how much a wind power station or a mast disturbs a nearby radar station. The tool calculates the signal to interference ratio caused by the wind power station or the mast and compares it against the signal to interference ratio required by the radar receiver. In order to calculate the interference caused by the wind power station or the mast the tool first calculates the radar cross section. The radar cross section describes how well an object reflects radar waves. The calculation methods are described in [A30].

Obstructions are stored in two databases (the terminology refers to a specific Swedish application of the Obstruction Manager). These databases are searched automatically to find potential obstructions that may interfere with radar coverage:

- **FIA:** Flight obstruction database, read-only from WRAP
- **Obsman:** Database where obstructions that are defined in the Obstruction Manager are stored (read/write from WRAP).

The test for harmful interference is performed against all radar stations (Class of Station LR) and aeronautical land stations (Class of Station FA) stored in the WRAPdB database.

Each time ObsMan is started the ObsMan database is searched for obsolete obstacles. Obstacles in a closed case with result OK to build is set to obsolete if they are not found in the flight obstruction database and are more than 2 years from the . A message with the number of obsolete wind power stations are shown when this search is finished. This is a part of implementation of the algorithm to include correct obstacles in the calculations.

Figure 16.1 shows a display of the Obstruction Manager Main tab. Under the Main tab all the general information about the applicant is filled in. The case number has to be a unique number, one for each case.

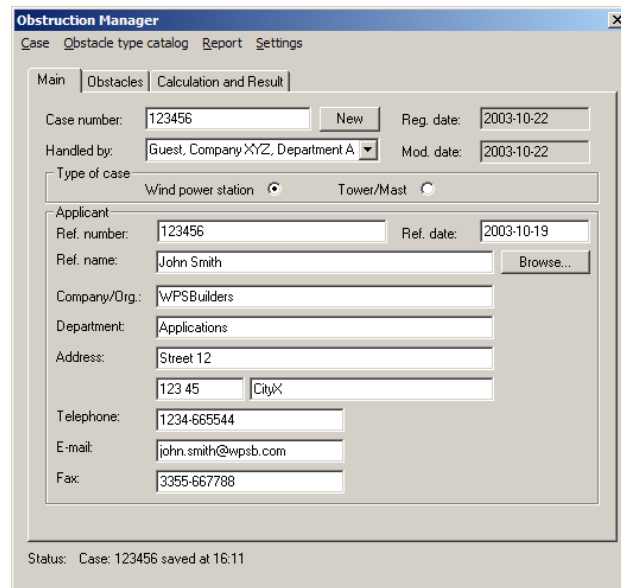


Figure 16.1: Obstruction Manager, Main tab.

The reference number is the number of the case before it is registered in the Obstruction Manager tool. The case menu contains **New**, **Open**, **Delete**, **Close**, **Save**, **Open External Case...** and **Print**. **New** creates a new case, **Open** opens an old case, **Delete** deletes a case, **Close** closes the active case and **Save** saves the active case in the database, **Open External Case...** open external obstacles (from .xml files) for calculation. **Print** gives the opportunity to print out a case with all its details or to print out the answering letter for a specific case.

Figure 16.2 shows the Obstacles tab. Under this tab all the new obstacles (wind power stations or masts) to be calculated upon are defined. The **New** button is pressed to define a new obstacle, the **Edit** button is pressed when an obstacle already defined is to be edited and the **Delete** button deletes the high-lighted obstacle. The **Duplicate** button can be used if there are several obstacles that are to be defined with similar characteristics. The **Duplicate** button used together with the edit box to the right tells how many times the obstacle should be duplicated. If **Show obstacles in Map Viewer** is marked then the defined obstacles are shown in the Map Viewer.

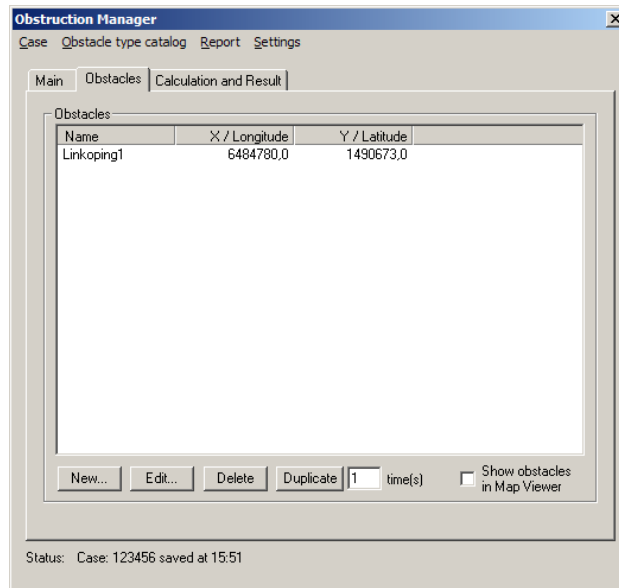


Figure 16.2: Obstacles tab.

Under the Obstacle type catalogue menu there is a possibility to define different types of wind power stations and masts.

Figure 16.3 shows the Calculation and Result tab. The calculation is done by pressing the calculate button under this tab and the result is presented in the Obstacle result window.

In the Obstacle result window there are five columns (Obstacle, Source, Radar, Comment and #Group Obstacles).

- Obstacle, presents the name of the obstacle.
- Source, indicates which source the obstacle has been gathered from. There are three possible obstacle sources: Current case, Obsman database and the FIA database.
- Radar, presents the result of the interference calculation against radar.
- Taras, presents the result of the calculation against aeronautical land stations.
- Comment, presents a comment about the calculation and can in some cases provide the user an indication on how to adjust the height parameters of the obstacle so that the case result becomes **OK**.
- #Group Obstacles, Indicates how many obstacles which are in the vicinity of the obstacle and that will be included in the calculation.

If there are several radar stations that have been calculated upon there is one result for each station listed in the window.

If all of the calculations in the list are **OK** then the case result becomes **OK** and if one or more of the calculations in the list is **Not OK** then the case result becomes **Not OK**. By pressing the **Generate answering letter** button a letter is generated including the comments written in the window to the right of the button. (If a case is **Not OK** but the user choses the mark it **OK** anyway, all the obstacles in the case will be regarded as OK.)

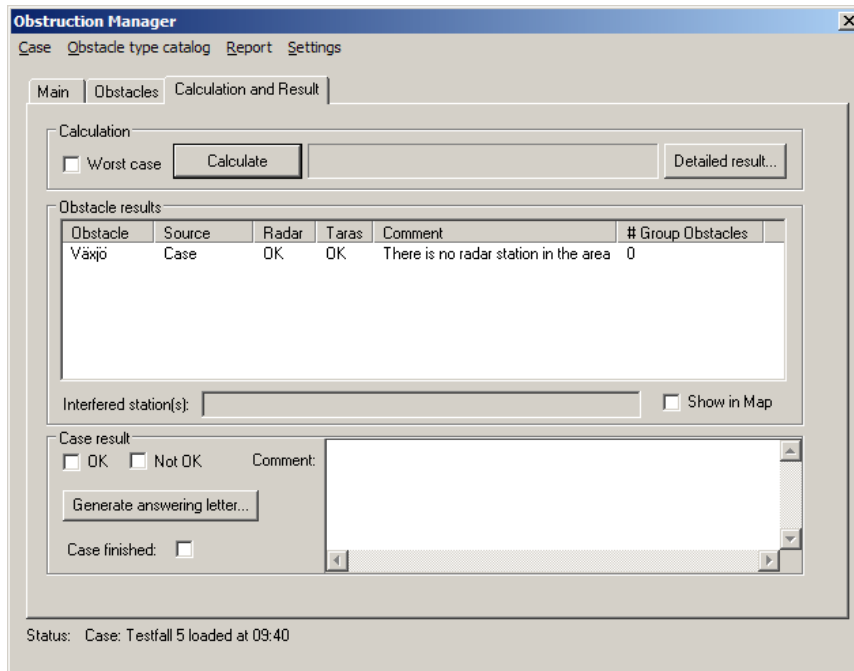


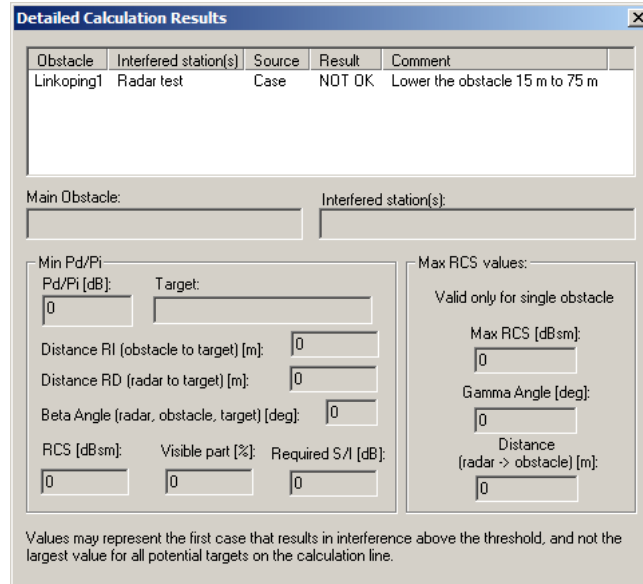
Figure 16.3: Calculation and Result tab.

If Case finished in **Figure 16.3** is checked, then it can only be re-opened by selecting **Open** and then high-lighting the finished case and pressing **Edit**.

When new obstacles interfere with already existing obstacles the result of the calculation can in some cases be misleading. An example of this is when a new windpower station interferes together with the existing obstacles, but the contribution from the existing obstacles dominates. Because of this fact ObsMan will alert the user (in these specific cases) if the interference power from the new obstacle is less than 0,05 % of the total interference and recommend that a worst-case calculation should be performed.

To perform a worst case calculation, check the check box *Worst case*. When a worst case calculation is selected ObsMan will calculate **every** obstacle individually in the case at **every** calculation point. Then ObsMan analyses if the new obstacle interference power is equal or less than 0,05 % of the interference power from the already existing obstacles. If the Obstacle is below this value the user will be recommended to approve the obstacle. Please note that a worst case calculation can be time-consuming and should only be performed when the ObsMan tool recommends it.

The button *Detailed result...* brings up a dialogue where some calculation results are presented in detail. Refer to **Figure 16.4**.



Obstacle	Interfered station(s)	Source	Result	Comment
Linkoping1	Radar test	Case	NOT OK	Lower the obstacle 15 m to 75 m

Main Obstacle: Interfered station(s):

Min Pd/Pi:

Pd/Pi [dB]: Target:

Distance RI (obstacle to target) [m]:

Distance RD (radar to target) [m]:

Beta Angle (radar, obstacle, target) [deg]:

RCS [dBsm]: Visible part [%]: Required S/I [dB]:

Max RCS values:

Valid only for single obstacle

Max RCS [dBsm]:

Gamma Angle [deg]:

Distance (radar -> obstacle) [m]:

Values may represent the first case that results in interference above the threshold, and not the largest value for all potential targets on the calculation line.

Figure 16.4: Detailed result values.

By marking an obstacle in the list the detailed result values are shown. In the Min Pd/Pi box Pd/Pi shows the signal-to-interference ratio, the beta angle is the angle radar-wind power station-calculation point, RI is the distance in meters between the wind power station and the calculation point, RD is the distance between the radar station and the calculation point. The radar cross section, RCS, is given in dBsm (dB relative to 1 square metre) and any terrain blocking is included in the value. The visible part is the part of the wind power station visible from the radar. The required S/I is the value of the radar station. The calculation stops when a target position is found where Pd/Pi value is less than the required S/I. The values in the Min Pd/Pi box are valid at this target position. If the minimum Pd/Pi values are greater than the required S/I the values corresponding to this minimum value are shown.

In the Max RCS box the Gamma angle is the angle between the incident plane of the radar wave and the normal plane of the tower of the wind power station. The RCS value is the maximum RCS value of the wind power station. No blocking effects are included.

For calculations with several wind power stations the values in the Max RCS box are not applicable and not shown.

By using **Filtered** under the Report menu there is a possibility to get a report of a compilation of already handled cases. **Figure 16.5** shows the different available filter options.

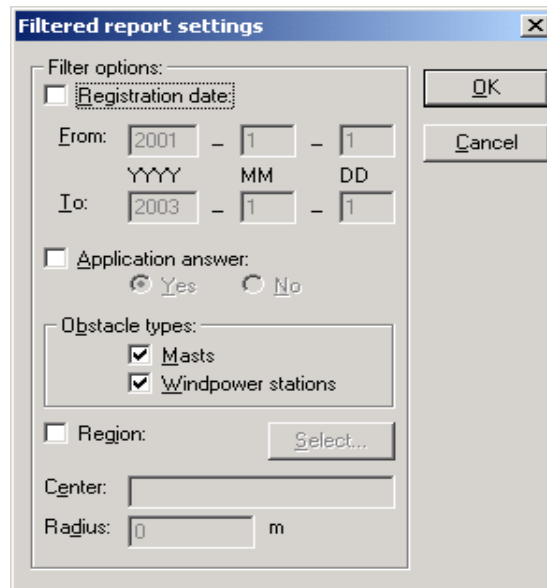


Figure 16.5: Filter options under the Report menu.

Under the Settings menu there are three different setting dialogues: Operator settings, Report template settings and Database settings and one Check Consistency alternative. In the Operator settings dialogue (see **Figure 16.6**) different operators of the tool can be defined.

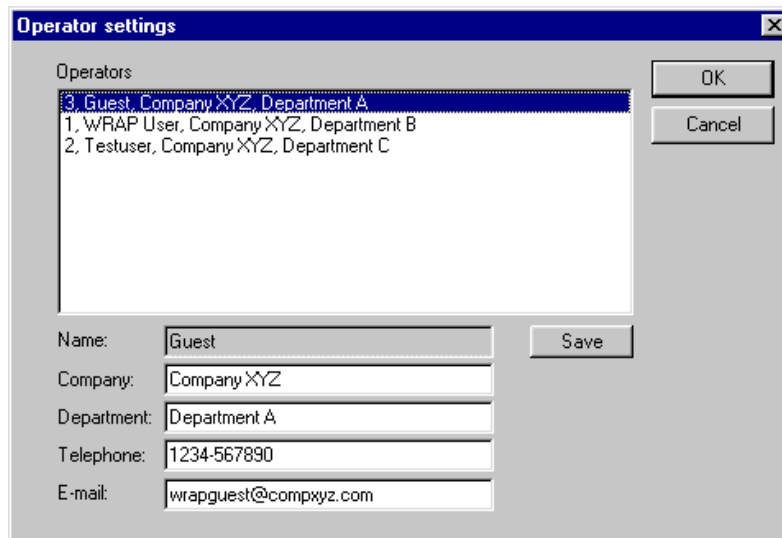


Figure 16.6: Operator settings window.

In the Report template settings dialogue (see **Figure 16.7**) the general information in the answering letter can be predefined.

Figure 16.7: Report template settings.

The third setting under the Settings menu is the Database settings dialogue (see **Figure 16.8**). Here the database transfer date must be entered.

Figure 16.8: Database settings.

The date is used when the calculation algorithm searches for obstacles in the databases. Since ObsMan uses both flight obstruction database and the obstruction manager database one obstacle might be present in both the databases. On order to find these duplicate entries the transfer date is used.

Note: The transfer date must be updated every time the Obstacle database is updated.

The Check Consistency alternative just checks if the databases are correct.

16.1.1 Calculation of external cases

ObsMan can import and calculate external obstacles. External obstacles are imported by pressing either the **Open External Cases...** or the **Search External Cases...** menu alternatives. The external cases must be in an .xml format to be possible to import. Both alternatives opens a dialogue where any .xml file shall be chosen..

Open External Cases opens all external cases which have not been calculated by ObsMan. The remaining obstacles are shown in the Import external case dialogue, see Figure 16.9.

Selecting Search External Case opens a new dialogue (see Figure 16.9). In this dialogue the user can filter out obstacles from a specific time period or cases with a certain number, which then will be available for calculation.

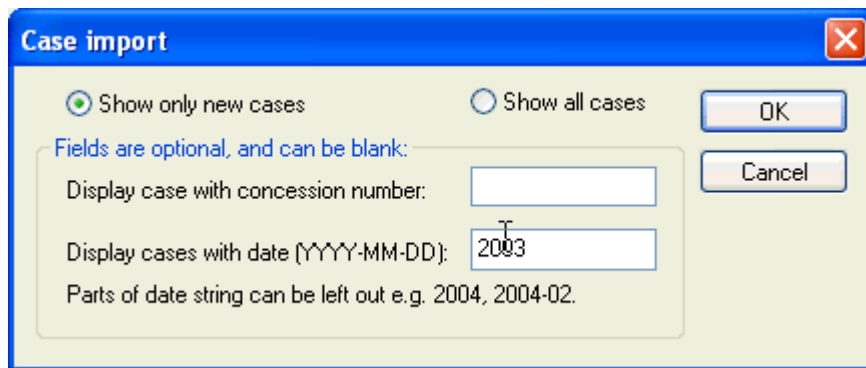


Figure 16.9: The Case import dialogue.

Independent of Open or Search External Cases..., the user than shall select an obstacle for calculation in the dialogue Import External case. To select an obstacle for calculation the user shall select an obstacle in the list and press **Open** to copy the obstacle data to ObsMan for calculation. (**Note:** Only one obstacle is possible to select at a time.) A maximum of 50 cases is shown in the dialogue. The Next and Previous buttons makes it possible to step to the next (or previous) 50 cases.

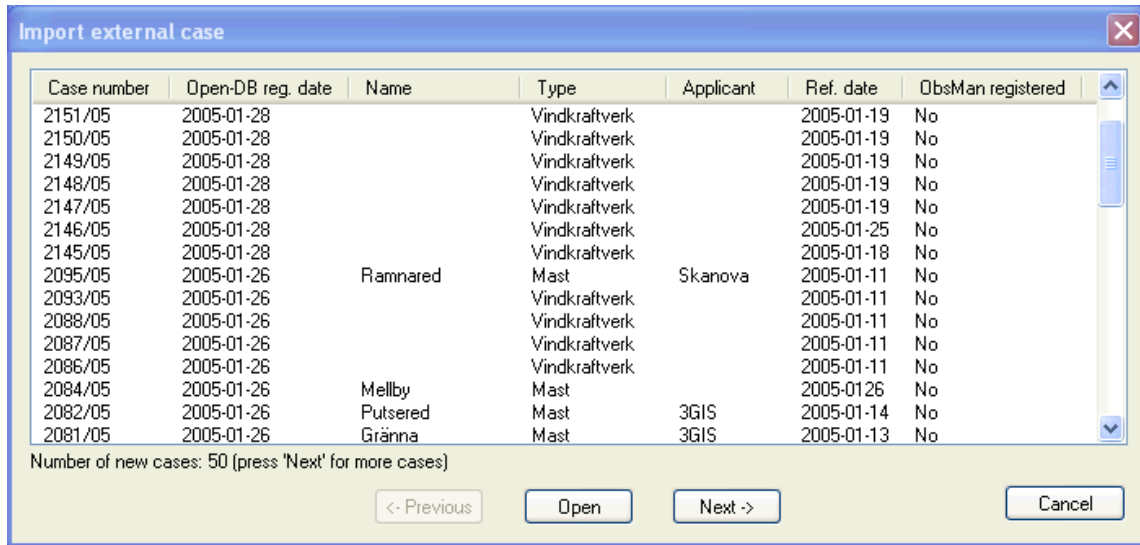



Figure 16.10: The Import external case dialogue.

When the obstacle has been imported to the ObsMan database the obstacle will be hidden from the user in the Import external case dialogue during the next ObsMan session. The case is marked Calculated during the same ObsMan session.

16.1.2 Example: Testing a wind power station

The following example illustrates how WRAP can be used to determine if a wind power station disturbs a radar station and how an answer can be generated to the applicant.

- Open **Obsman.wpr**. This project contains one radar station operating at 9900 MHz. Mark the radar station in the project and show it on the map.
- Press the  **Obstruction manager** button in the menu bar.
- Make the following settings and selections:
 - Select **<Case>**-<New>
 - Case number: 123456
 - Handled by: Guest, Company XYZ, Department A
 - Ref. number: 123456
 - Ref. date: 2003-10-22
 - Ref. name: Enter your name
 - Enter appropriate data in the Company/Org and the three address entry fields.
- Then go to the **Obstacles** tab and create a new wind power station by selecting the **[New]** button.

- Make the following settings and selections.
 - Name: Linkoping1
 - Position: **[Edit...]** X: 6484780 Y: 1490673
 - Note that the ground height was automatically updated with a value 49 m from the raster database.
 - Manufacturer:**[Browse...]** and select Westas Wind A/S.
 - Rotordiameter:55 m
 - Tower height: 90 m
 - Tower Base diameter: 10 m
 - Tower Top diameter: 6 m
 - Click **[OK]**.
- Go to the **Calculation and Result** tab and press **[Calculate]**.
- Note that the result is NOT OK in the Result Box. Also note the comment and change the height of the obstacle to the one recommended by ObsMan.
- Go to the **Calculation and Result** tab and press **[Calculate]**.
- Note that the result now is OK and finish the case by ticking the Case finished box.
- To generate an answer fill in some text in the comment window and press **Generate answering letter**.