32ND ITU WORLD
RADIOCOMMUNICATION SEMINAR

ITUWRS GENEVA2026

7–11 December 2026
Geneva, Switzerland

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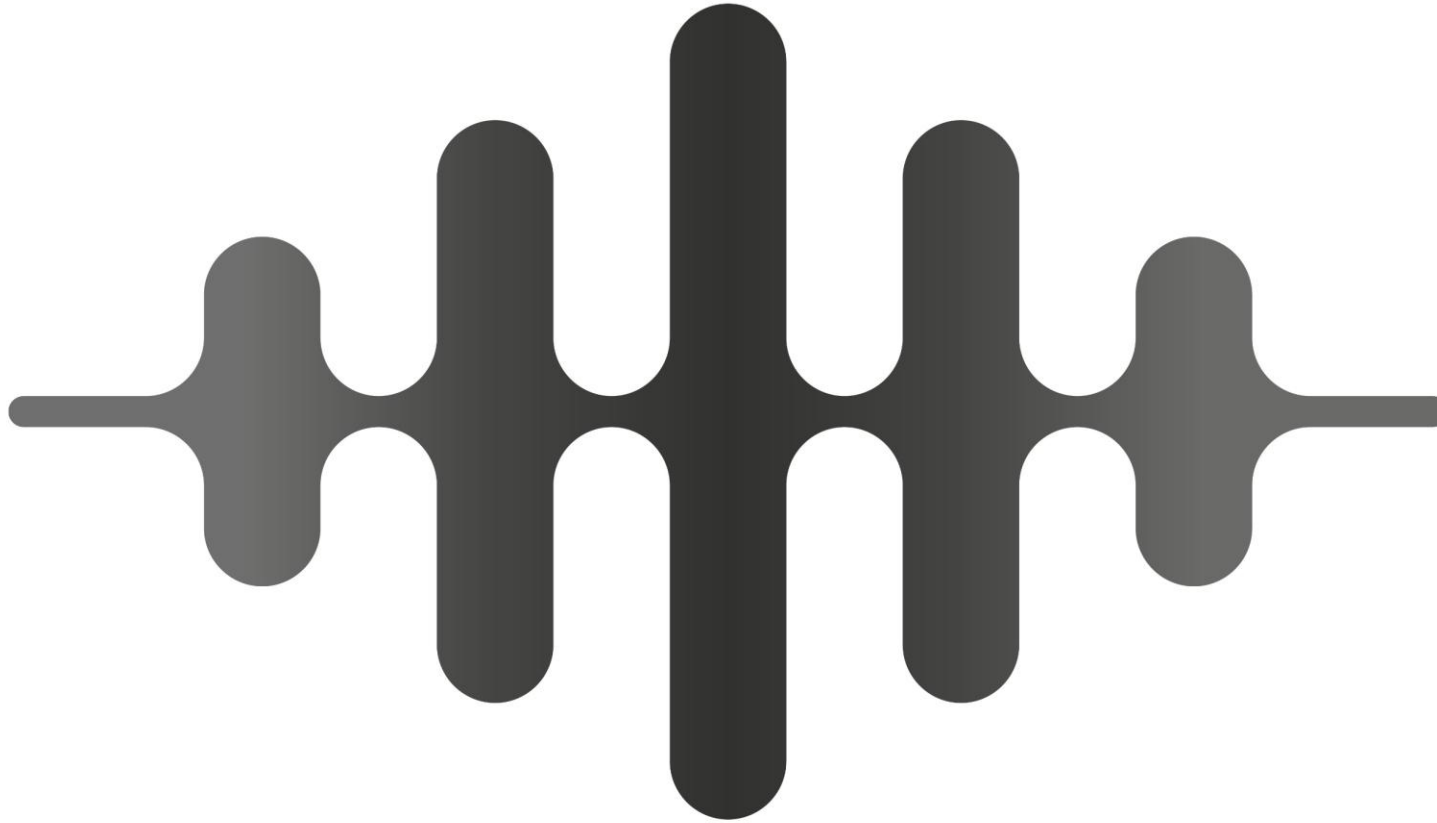

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ITU

ITU World Radiocommunication Seminar

GE84 Agreement - Advanced

7-11 December 2026, Geneva, Switzerland

Geneva 1984 Software Tool for Radionavigation Compatibility

11.12.2026
09:00 – 10:20



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GE84 Radionavigation Compatibility tool

Software tools for the GE84 Agreement



Outline

1. Purpose and principles
2. Method and interference types (Rec. ITU-R SM.1009-1)
3. Input data
4. Submitting a calculation
5. Results
6. Exercise

Purposes and regulatory basis

- Examines whether **FM broadcasting (BC) stations** of the GE84 Plan may cause potential interference to ILS localizers and VOR stations in the **aeronautical radionavigation (ARNS) service**
- Applies the General Assessment Method (GAM) of **Recommendation ITU-R SM.1009-1**
- Supports coordination between FM sound broadcasting and the ARNS under **Article 4** of the Agreement (§4.2.2 f) to:
  - assess your new or modified FM assignments before submitting them (notice file)
  - examine the requirements published in Part A of the GE84 Special Sections (§4.2.2 f)

FM broadcasting
87.5 – 108 MHz
GE84 Plan

Aeronautical radionavigation
108 – 117.975 MHz
ILS localizer · VOR

Adjacent band compatibility:
impact of the FM transmitters on ARNS receivers

The results support coordination between administrations; they do not replace it

Four types of interference (SM.1009-1)

Type A

generated in the BC transmitter

A1 — Spurious emissions and radiated intermodulation (IM)

Spurious emissions or IM products of co-sited BC transmitters fall in the ARNS band (the tool assesses IM)

Stations: BC station + database stations co-sited with it (≤ 1 km)

A2 — Out-of-band emissions

Out-of-band emissions (sidebands) of the BC transmitter close to the ARNS frequency

Stations: BC station alone, when $\Delta f \leq 300$ kHz

Type B

generated in the ARNS receiver

B1 — Receiver intermodulation

Intermodulation generated in the ARNS receiver by strong BC signals

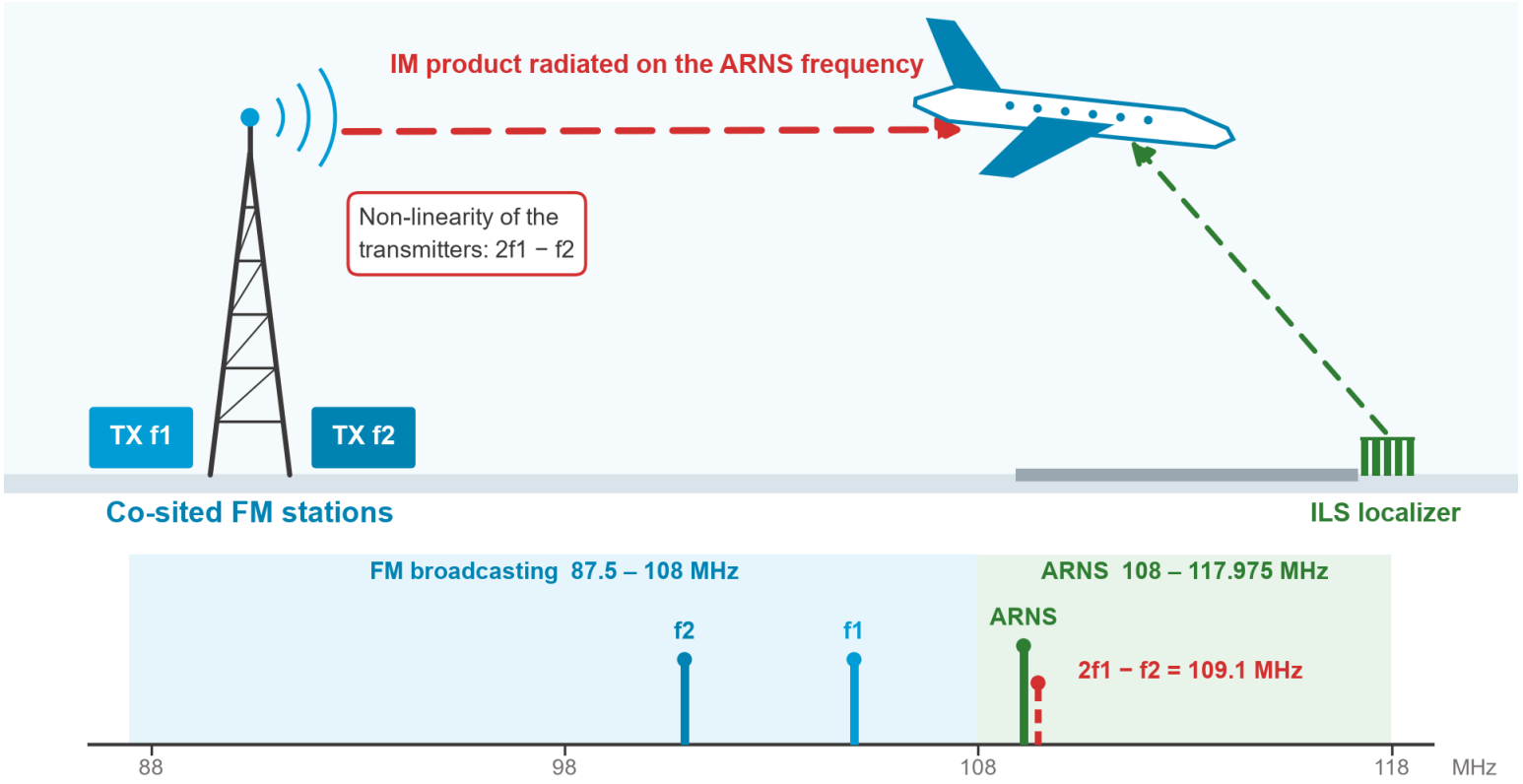
Stations: BC station + other BC stations in line of sight, above their cut-off value

B2 — Desensitization

Overload of the ARNS receiver by a strong BC signal

Stations: BC station alone

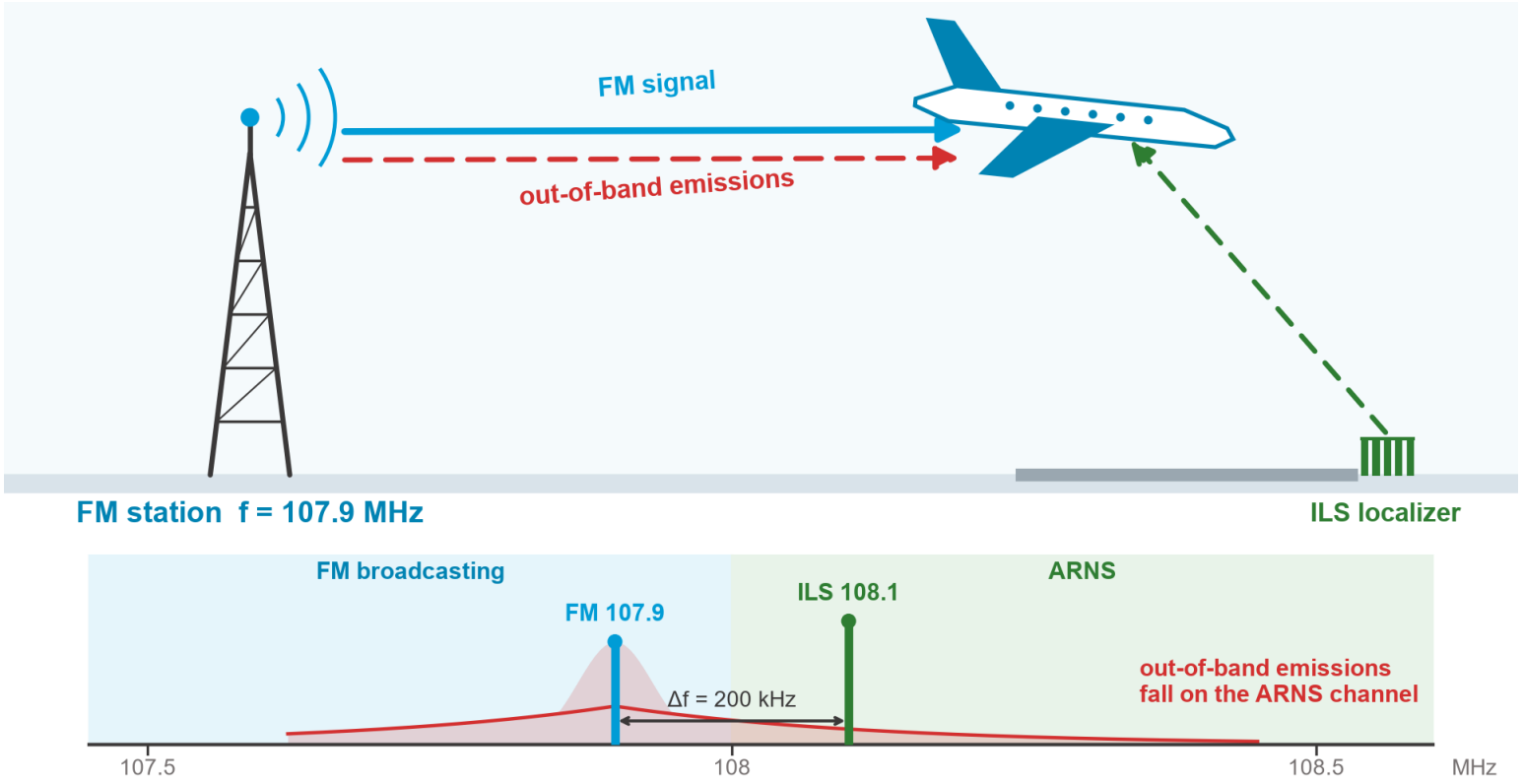
A1 · Spurious emissions and intermodulation



- **Where:** generated from transmitters of co-sited BC stations
- **Stations:** the assessed BC station + co-sited database stations (≤ 1 km) operating on a different frequency
- **Test points:** within 125 km of the BC station and in line of sight, where an IM product falls within 200 kHz of the ARNS frequency
- **Margin** = E + PR − E_w
  with the recommended suppression levels of the transmitters for Type A1
  (ref. Table 1, Annex 1)

Example: f1 = 105.0 MHz and f2 = 100.9 MHz on the same site give 2f1 − f2 = 109.1 MHz, that fall on an ILS channel.

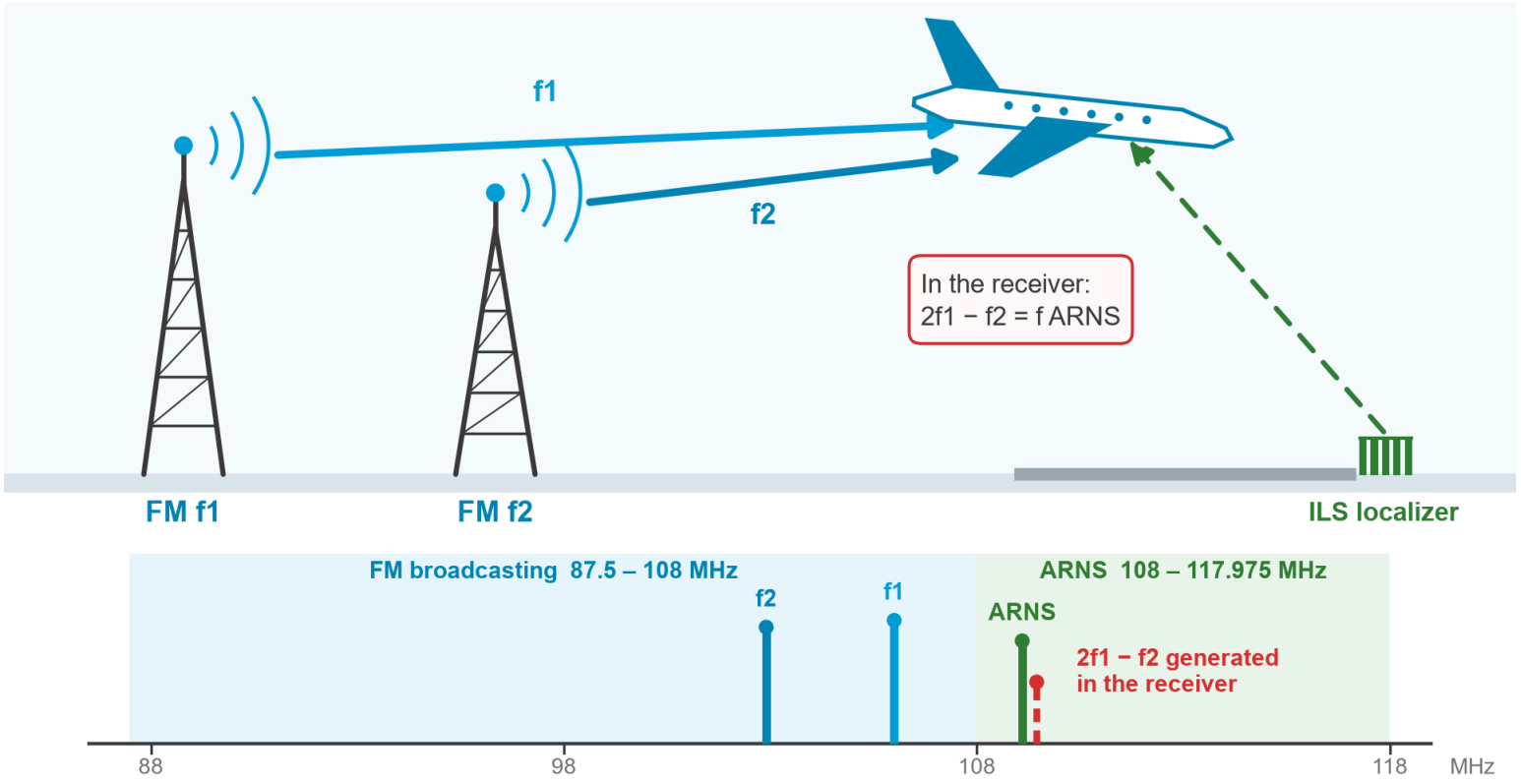
A2 · Out-of-band emissions



- **Where:** out-of-band emissions generated by the assessed BC transmitter
- **Stations:** the assessed BC station alone, when frequency separation Δf ≤ 300 kHz
- **Test points:** the test points of the couple in line of sight of the BC station
- **Margin** = FS + PR − E_w;
  PR depends only on Δf (Annex 1 Table 3)

Only the FM stations at the top of the band can be concerned: 300 kHz from an ARNS channel at 108.05 MHz or above.

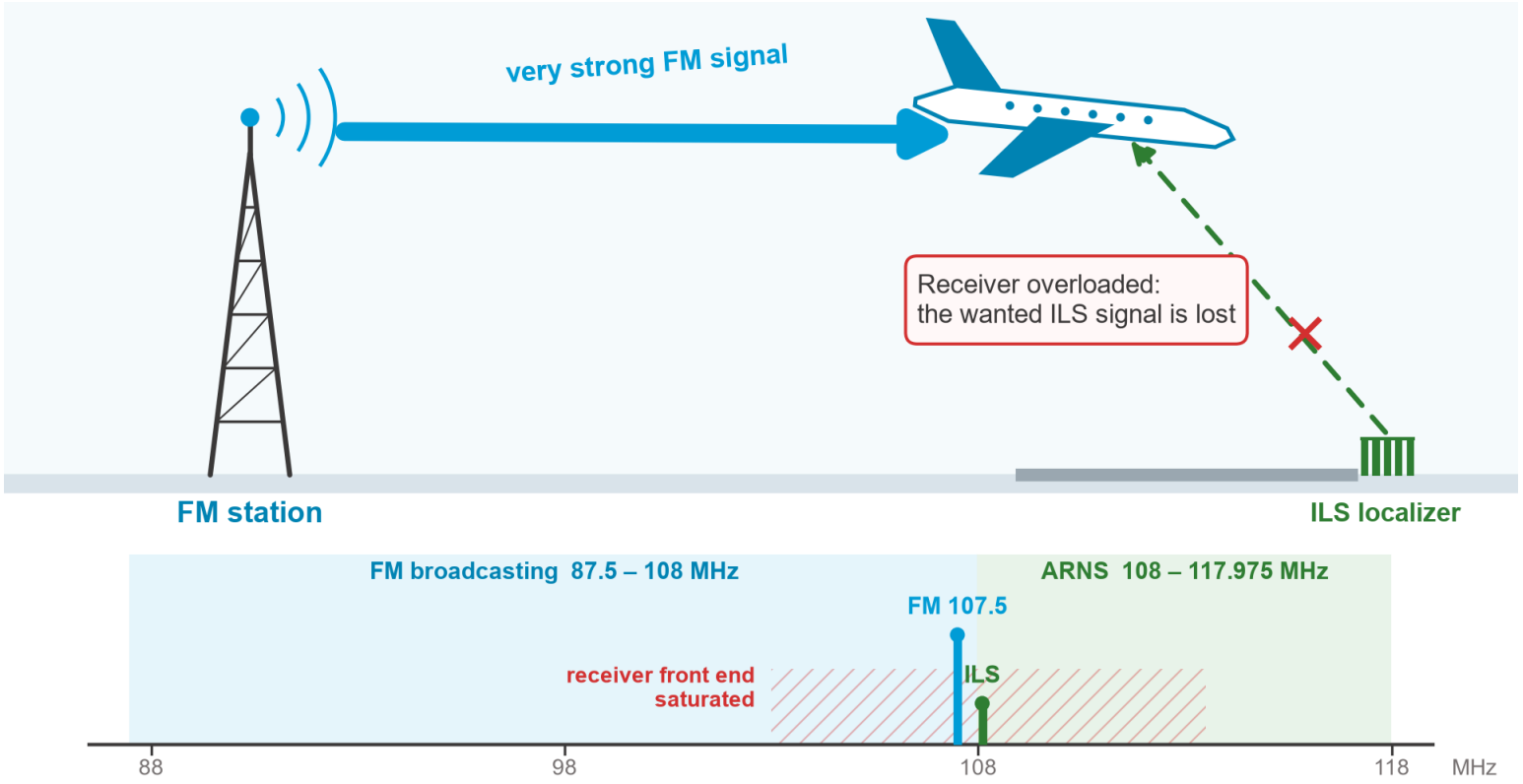
B1 · Receiver intermodulation



- **Where:** generated in the ARNS receiver due to the non-linearity of its front end
- **Stations:** the assessed BC station + other BC stations in line of sight and above the applicable cut-off value
- **Test points:** where an IM product is within 200 kHz (Montreal) or 150 kHz (ICAO Annex 10 1998) of the ARNS receiver frequency and at least one BC component reaches its trigger value
- **Criteria** depend on the ARNS receiver immunity characteristics
(ref. eq. 7 Montreal, eq. 12 ICAO)

Unlike A1, the stations need not be co-sited: strong signals from different BC sites may mix and interfere with the ARNS receiver.

B2 · Desensitization



- **Where:** in the ARNS receiver (overload by one strong signal)
- **Stations:** the assessed BC station alone
- **Test points:** within 125 km of the assessed BC station and in line of sight
- **Margin** = Rx power − N_max (ref. eq. 9 Montreal, eq. 13 ICAO) assuming the minimum wanted ARNS field strength: 32 dB(μV/m) ILS, 39 dB(μV/m) VOR

N_max is independent of the test point, as B2 calculations always assume the minimum wanted ARNS field strength at the aeronautical receiver.

How the analysis works

1 Input

ARNS stations

VOR DOC range, ILS shaded zone and fixed test points

BC assignments

your own or from the database

→

2 Screening

A1/B2: within 125 km + DOC radius; A2/B1: line-of-sight and signal range (Annex 2, §3.1.2)

→

3 Test points

Fixed points + points generated for each BC station

→

4 Margins

A1, A2, B1, B2 at each test point in line of sight:

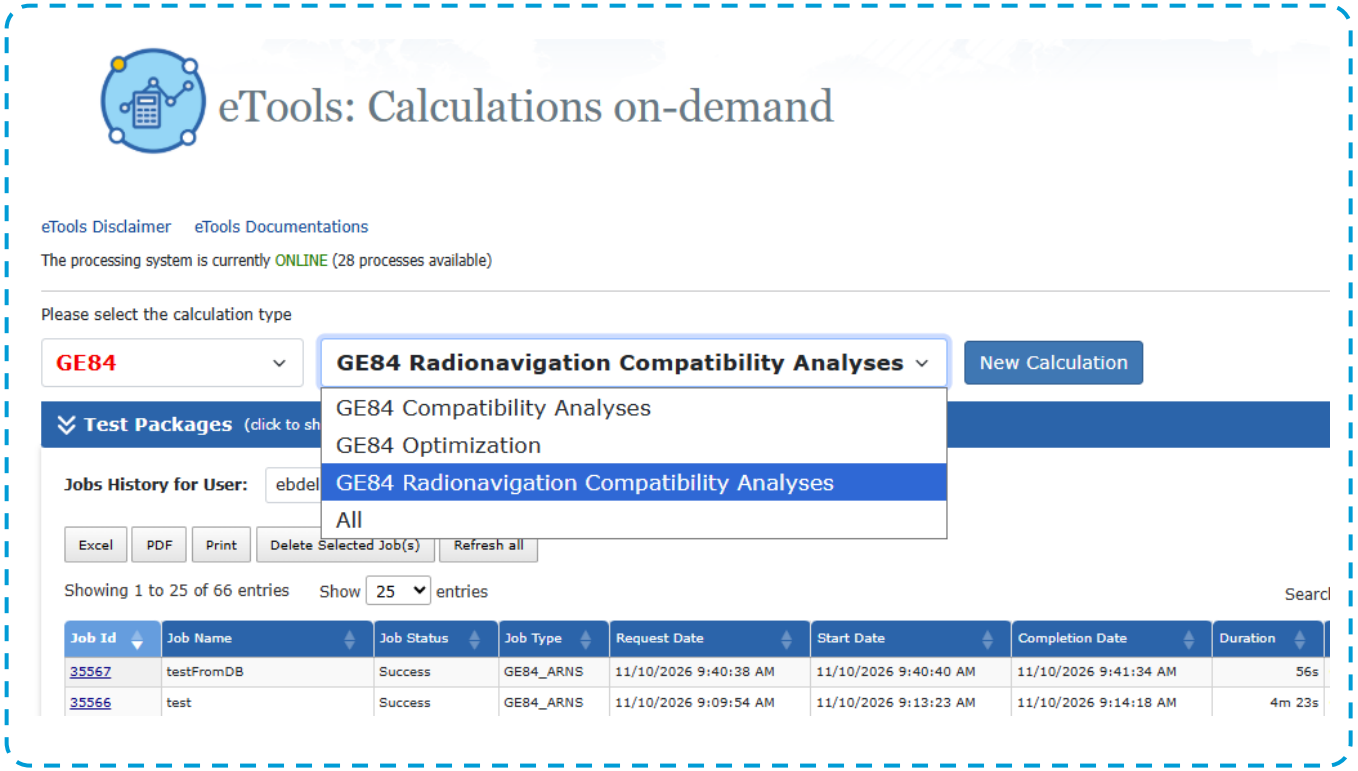
compute Rx levels and apply protection criterion (dB)

→

5 Result

A positive margin (Margin > 0 dB) for any interference type at any test point indicates an affected ARNS station

- **ARNS receiver types:** ICAO Annex 10 (1998) or Montreal: same method and criteria for Types A1 and A2; different criteria for Types B1 and B2 (ref. Annex 1 §4.3 / §4.2)
- **Database stations:** the BC stations of the GE84 Plan are the co-sited partners (Type A1) and the other signals at the test points (Type B1); optionally with the TIP (Consider Tip)



Log in and select the tool

1. Log in with your **ITU TIES account**
2. Select the calculation type **GE84**
3. Select **GE84 Radionavigation Compatibility Analyses**
4. Click **New Calculation**

https://www.itu.int/ITU-R/eTerrestrial/eBroadcasting/ECalculations

The user guide of the tool is available under **eTools Documentation**

What you provide

1 ARNS stations to protect

ILS/VOR file – always required

- Plain text file (.txt), one station per line, a header line
- Separators: tab, comma or semicolon; decimal dot
- ILS: localizer bearing to approach; VOR: DOC range
- Prepare the input with a spreadsheet / text editor, or build it with the form **Build the ILS/VOR file**
- **Only one ILS/VOR file per job.**

2 BC stations to examine

Option FM BC Stations

Option	Assessed FM BC station(s)
Notice File	Your own new or modified FM assignments: T01 / GE84 notice, validated online
ITU GE84 SS Part A	Requirements of Part A (§4.2.2 f): select the affected and interfering Adm

The notice files are prepared as for the other GE84 tools: **eQuery**, **myAdmin** or **TerRaNotices**, validated with **eValidation**

The ILS/VOR file

Col.	Field	Rule
1	Station Name	Required
2	Longitude	Decimal degrees, East +, −180 to 180
3	Latitude	Decimal degrees, North +, −90 to 90
4	Antenna Height (m)	Above ground, > 0
5	Frequency (MHz)	A valid ILS or VOR channel
6	Type of Station	ILS or VOR
7	Localizer bearing to approach (°T)	ILS only, 0 to < 360 (empty for VOR)
8	DOC Range (km)	VOR only, > 0 (empty for ILS)

Example (semicolon-separated, header line ignored)

```
Name;Lon;Lat;Height;Freq;Type;Bearing;DOC
ILS1;6.1092;46.2381;10;109.90;ILS;40;
VOR1;6.0656;46.2522;8;114.60;VOR;;110
```

ILS localizer channels

.10 .15 .30 .35 .50
.55 .70 .75 .90 .95
40 channels

VOR channels

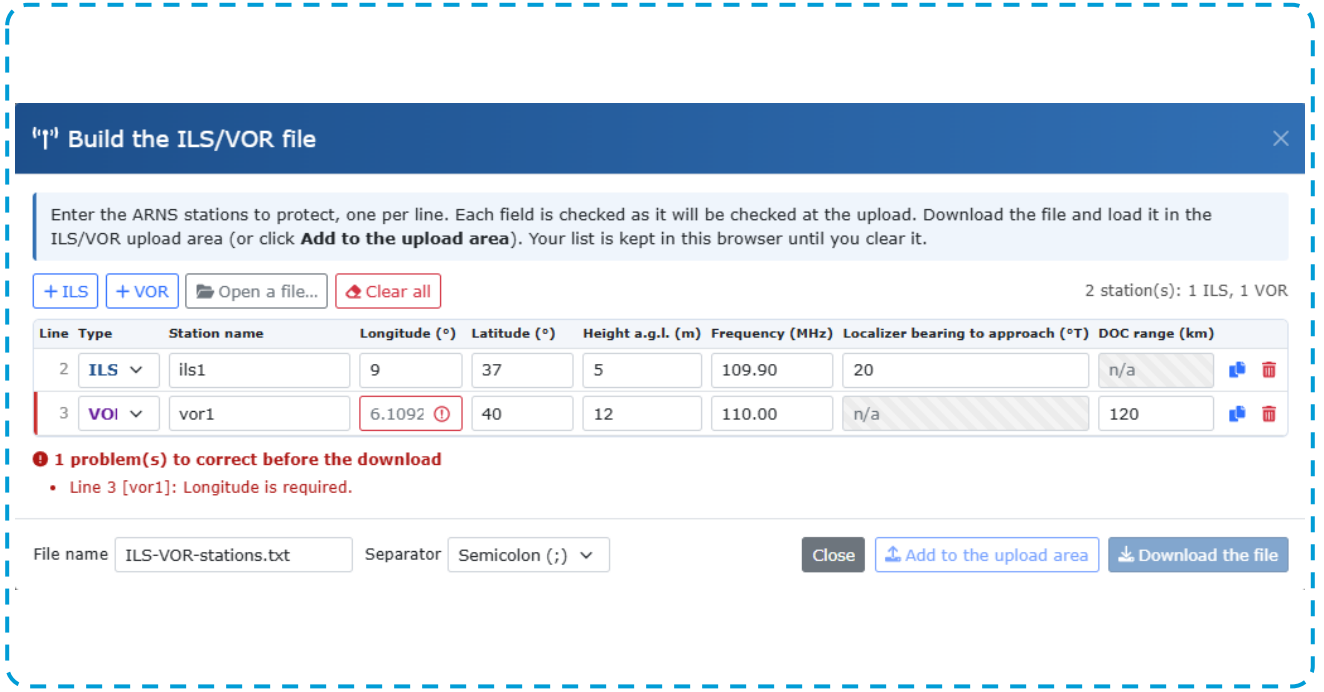
108.05–111.85: interleaved VOR channel
112.00–117.95: every 0.05 MHz
108.00 MHz is not accepted

Bearing is referred to the True North (°T)
It is from the localizer toward the approach area

Field 7 is blank for VOR
Field 8 is blank for ILS.

Build the ILS/VOR file from the form

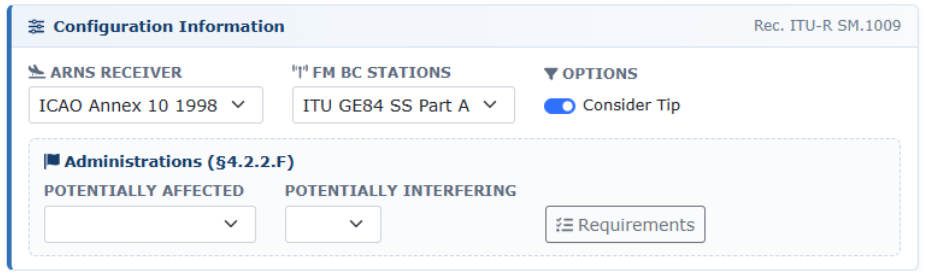
- **+ ILS / + VOR** add a station; rows can be duplicated or deleted
- Every field is validated as you type, with the rules and messages of the upload
- The frequency field proposes the valid channels for the aeronautical station type
- Coordinates in decimal degrees or D M S (46 14 17.2 N)
- **Open a file…** to correct an existing file
- **Download the file** or **Add to the upload area**



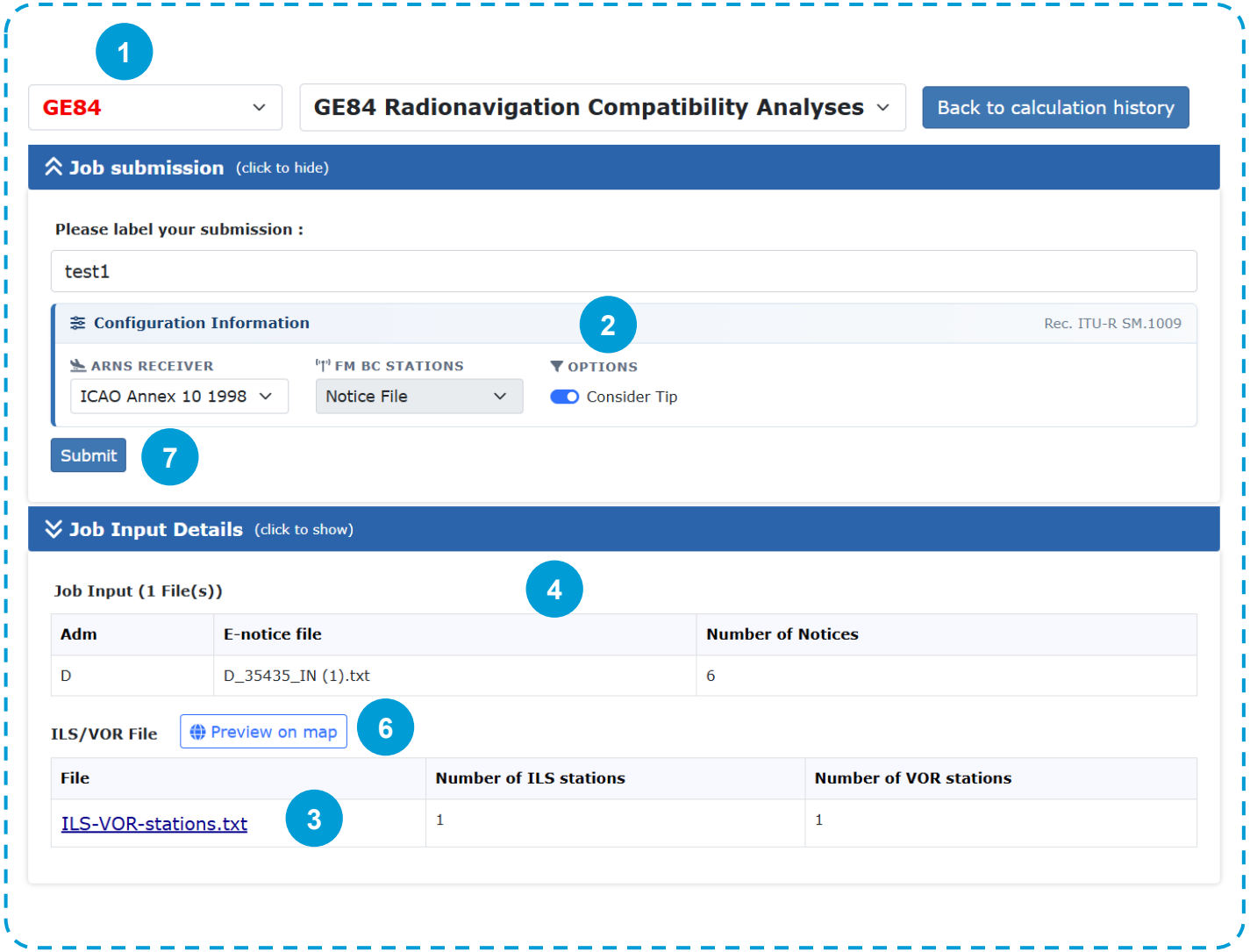
Link **Build the ILS/VOR file** above the ILS/VOR upload area

Configuration information

Option	Values	Meaning
ARNS Receiver	ICAO Annex 10 1998 Montreal	Immunity of the ARNS receivers: B1 and B2 criteria differ
FM BC Stations	Notice File ITU GE84 SS Part A	Source of the BC stations to examine
Consider Tip	on / off	Include the GE84 entries (ADD/MODIFY) in the database not yet recorded in the Plan
Affected / Interfering Adm (§4.2.2 f)	administration	GE84 SS Part A only



The configuration and the input files cannot be changed after submission: use **New Submission**



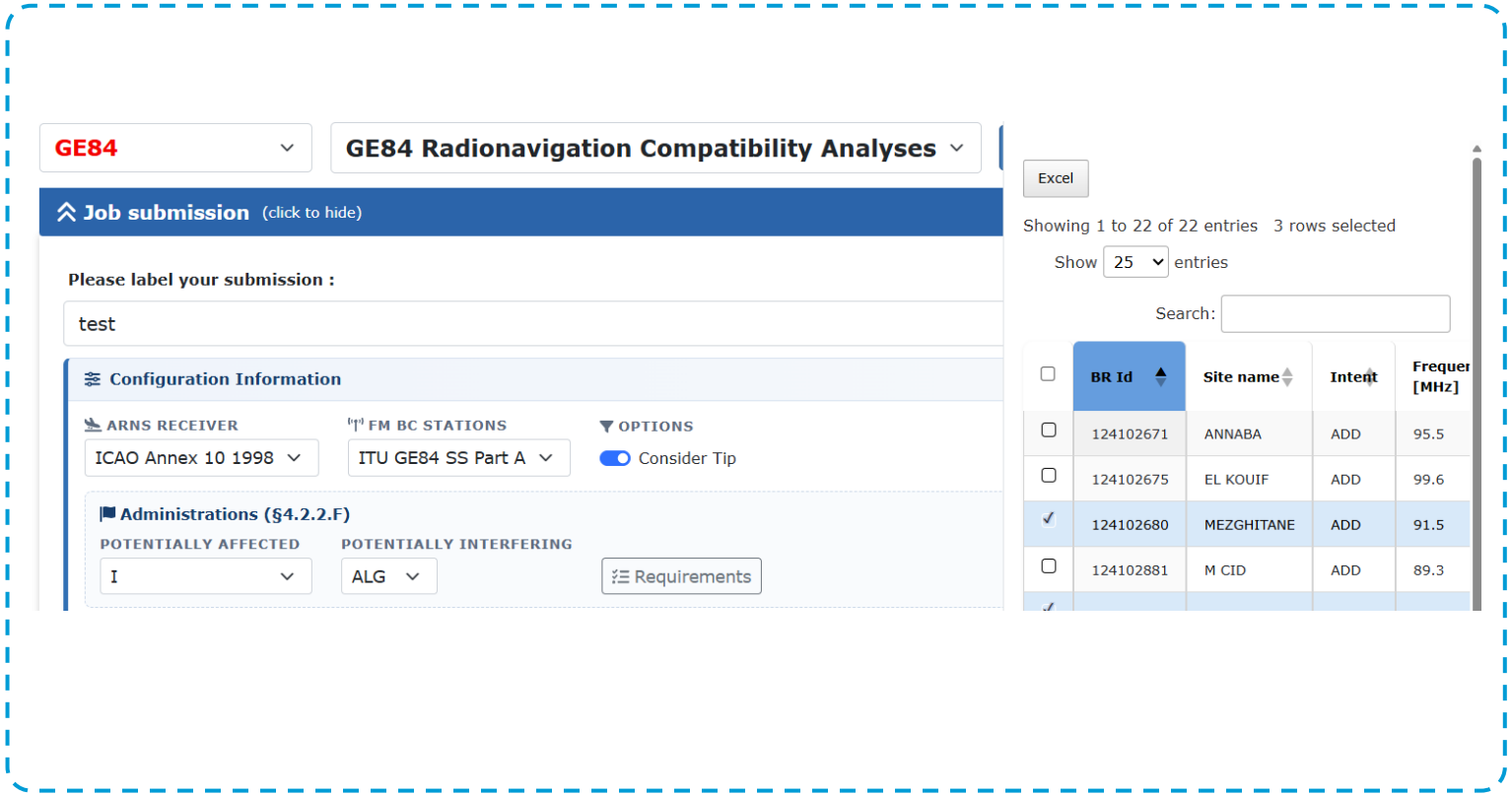
Upload and submit a new calculation

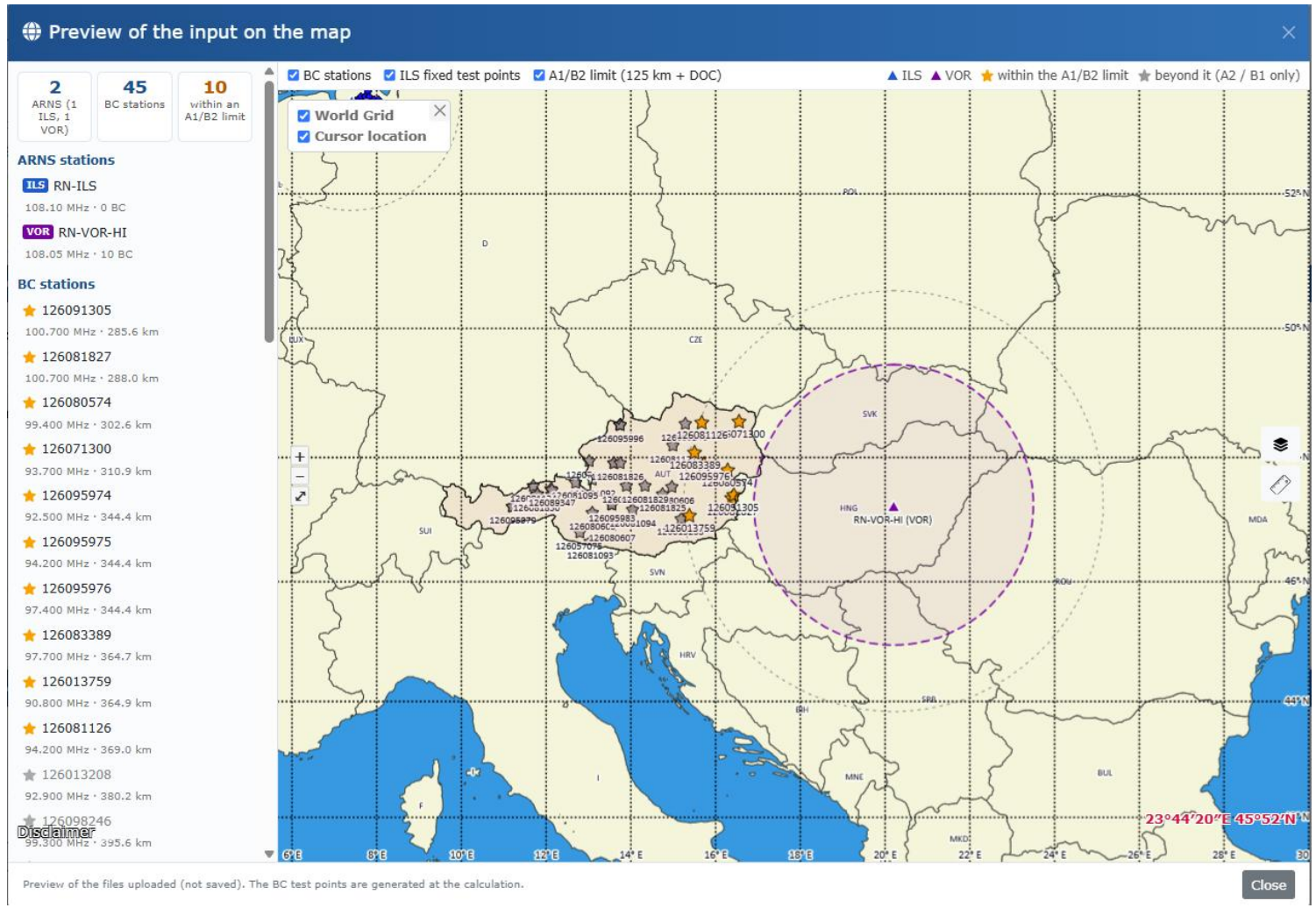
1. Select **GE84**, the tool, then **New Calculation**
2. Set the **Configuration Information**
3. Drop the **ILS/VOR file** (or build it from the form)
4. **Notice File:** drop the T01 / GE84 file
   GE84 SS Part A: select the Adm and the Requirements
5. Click **Upload File(s)**: the files are checked and listed in the Job Input
6. **Preview on map** (optional)
7. Give the job a name and click **Submit**

You are notified by email when the results are ready; follow the job in the calculation history

Examining GE84 SS Part A requirements

- Set **FM BC Stations** to **ITU GE84 SS Part A**
- Choose the **Affected Adm** (its ARNS stations) and the **Interfering Adm** (its FM requirements)
- Click **Requirements**: the potential interfering requirements (§4.2.2 f) are listed with BR Id, site, intent and frequency
- Select the requirements to examine and submit the calculation





Check the input on a map

After **Upload File(s)**, click **Preview on map** next to the ILS/VOR File table

ILS station, with DOC, shaded zone and fixed test points

VOR station, with its DOC circle

A1/B2 limit: 125 km + DOC radius

BC station within an A1/B2 limit: assessed for all types

BC station beyond every A1/B2 limit: A2/B1 only, if in line of sight

If no BC station is within an A1/B2 limit: no A1 or B2 can be found.
Check the coordinates before submitting.

From summary to evidence at the test point

Compatibility Summary

One row per ARNS station: affected? which types?

→

Results per BC Station

For one ARNS station: one row per BC station examined

→

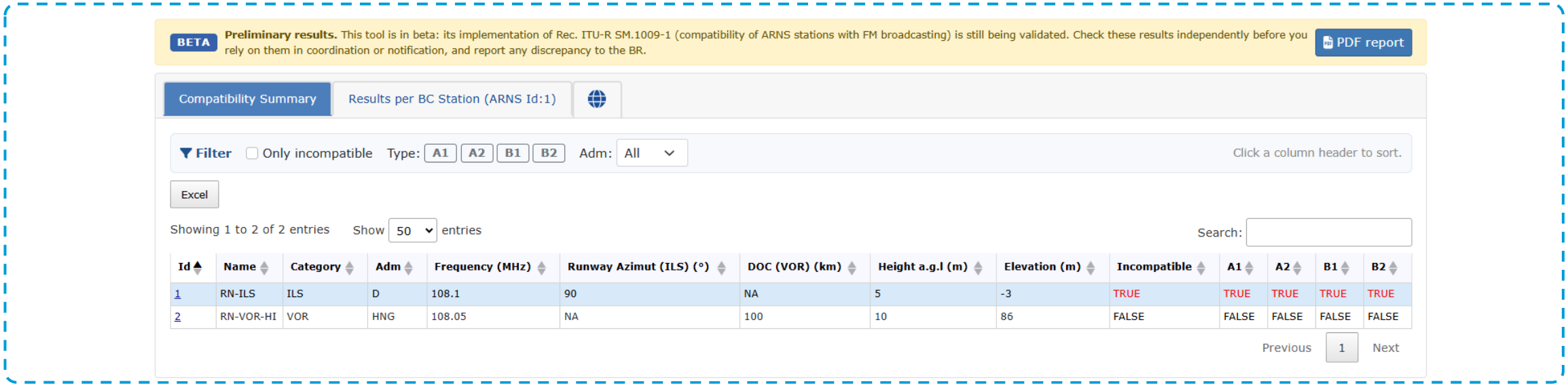
Interference Details

One pair and one type: values used and results per test point

→

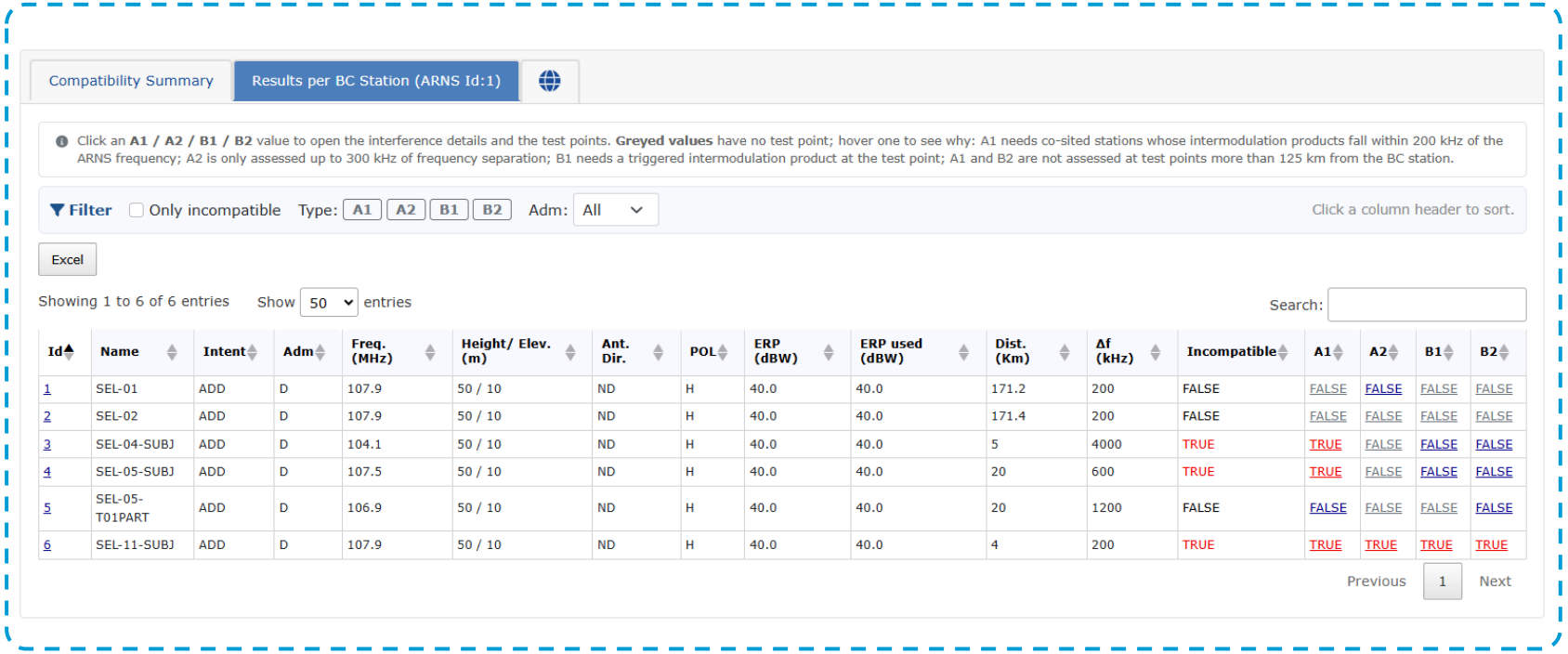
Map

Stations, coverage, test points and stations involved



Who is affected and by whom

- **Compatibility Summary:** Is Affected and A1, A2, B1, B2 per ARNS station
- Click the **Id** of an ARNS station: its **Results per BC Station** and its map
- Per BC station: frequency, e.r.p. used, distance, Δf, and **TRUE in red** for each type with a positive margin
- Click a TRUE value: the **Interference Details** of the pair
- **Filter bar:** only incompatible, by type, by Adm

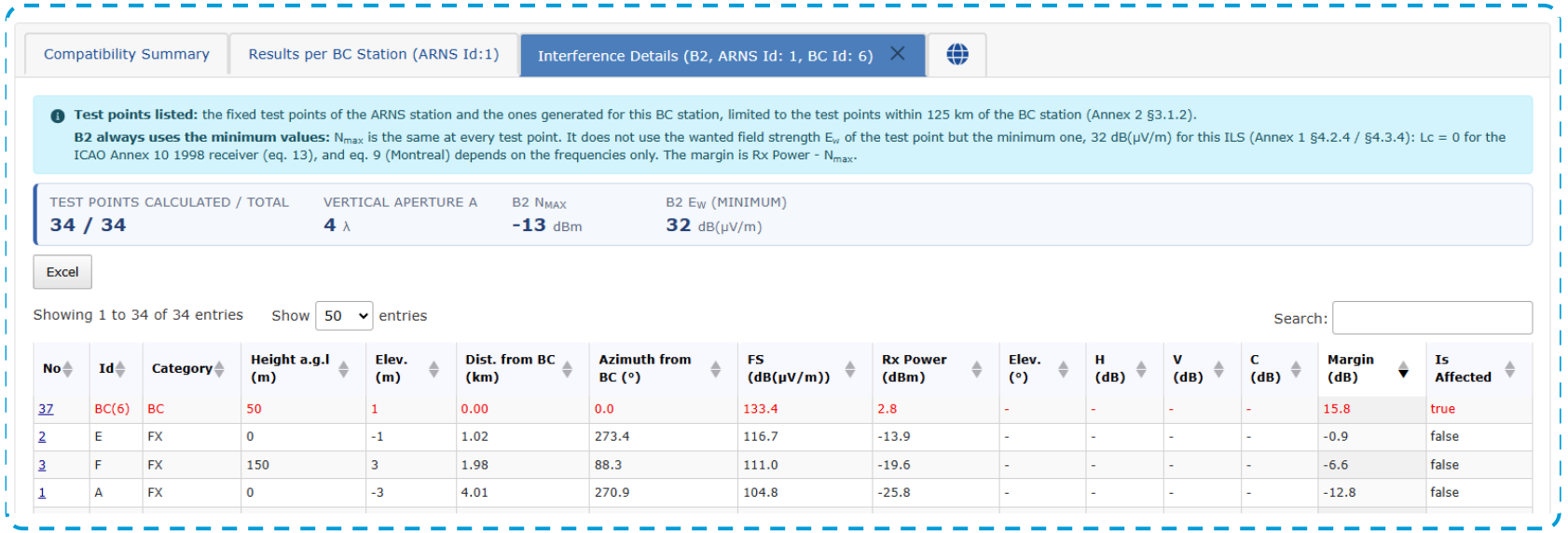


Hover a column header to see its definition

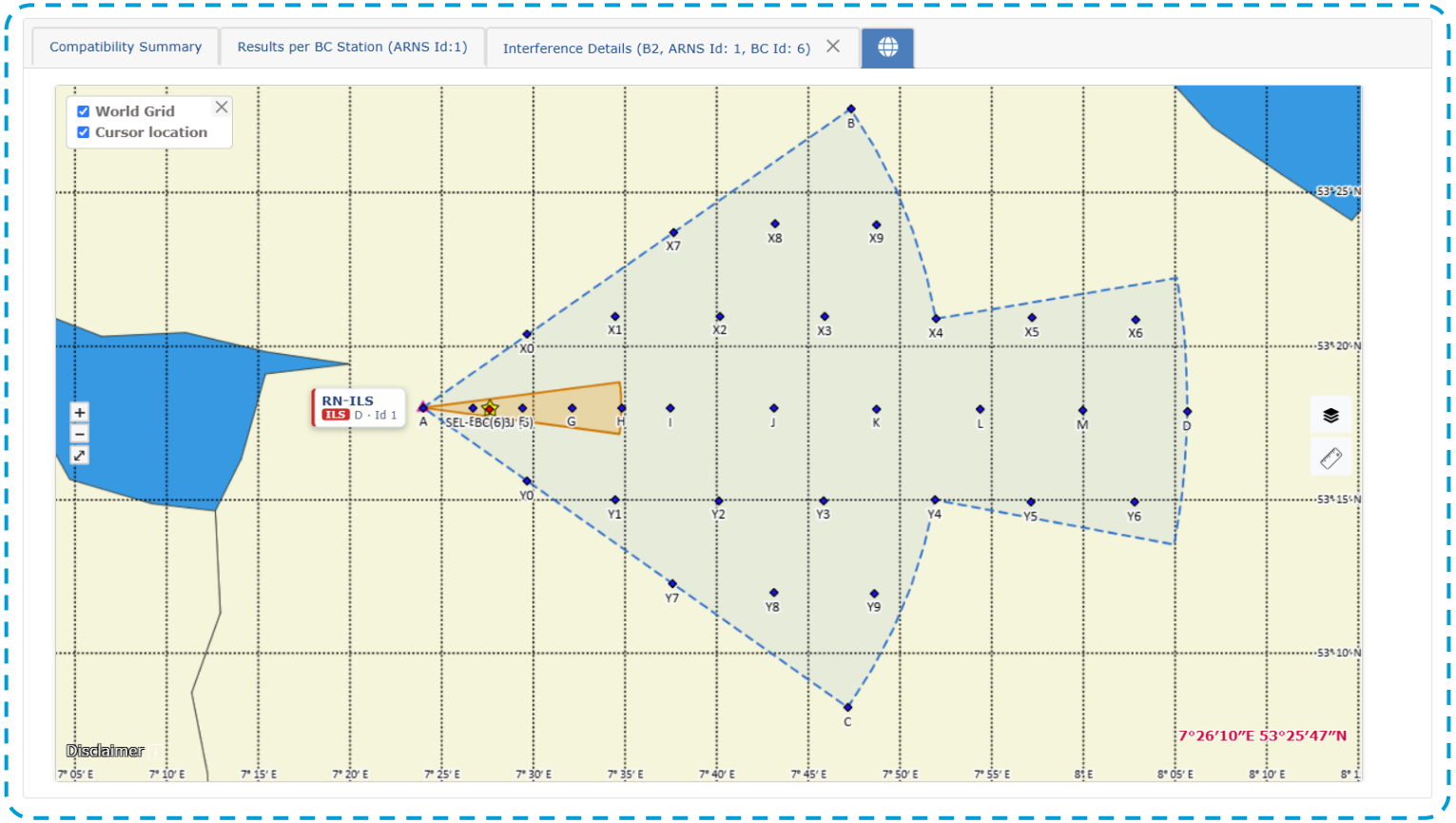
A grey value has no test point: hover it to see why

Interference details of a ARNS station – BC assignment pair

- The tab recalls the type, the ARNS Id and the BC Id
- A box gives the **values used**:
  - A1: suppression and co-sited stations,
  - A2: protection ratio
  - B1 cut-off and trigger values
  - B2 N_max
- One row per **test point**: FS, Rx power, corrections H, V, C, margin; positive margins in red
- A1 / B1: the **worst intermodulation product** and its contributors
- Click a test point **No** to show it on the map



No	Id	Category	Height a.g.l (m)	Elev. (m)	Dist. from BC (km)	Azimuth from BC (°)	FS (dB(µV/m))	Rx Power (dBm)	Elev. (°)	H (dB)	V (dB)	C (dB)	Margin (dB)	Is Affected
37	BC(6)	BC	50	1	0.00	0.0	133.4	2.8	-	-	-	-	15.8	true
2	E	FX	0	-1	1.02	273.4	116.7	-13.9	-	-	-	-	-0.9	false
3	F	FX	150	3	1.98	88.3	111.0	-19.6	-	-	-	-	-6.6	false
1	A	FX	0	-3	4.01	270.9	104.8	-25.8	-	-	-	-	-12.8	false



See where and why

- ARNS station affected (green: not affected)
- ILS DOC (dashed blue) and shaded zone (orange)
- VOR DOC circle
- ILS fixed test point
- Test point generated for the BC station
- Test point with a positive margin
- BC station of the result
- Site of the stations of an IM product (number of stations)

Exporting the results

PDF PDF report

- Job, configuration and input files
- Overview: ARNS stations affected, pairs, pairs by type
- Compatibility Summary
- For each affected ARNS station: its incompatible BC stations with the **worst margin** per type and the test points affected / assessed
- The map, as displayed

XLS Excel export of the tables

Each table has an Excel button; it exports the rows as filtered



GE84 Radionavigation Compatibility Analyses

Compatibility of FM broadcasting stations with aeronautical radionavigation stations (Rec. ITU-R SM.1009-1)

BETA - preliminary results. The implementation of Rec. ITU-R SM.1009-1 is still being validated: check these results independently before relying on them in coordination or notification.

Job and configuration

Item	Value
Job Id	35435
Job name	SEL-01
Status	Success
Report generated	11/10/2026, 4:09:56 PM
ARNS receiver	ICAO Annex 10 1998
FM BC stations	Notice File
Consider TIP	Yes
ILS/VOR file	RN-ILS-VOR-HI.txt (1 ILS, 1 VOR)
BC stations	- (, - notice(s))

Overview

2	1	12	3	3	1	1	1
ARNS stations	affected ARNS stations	BC / ARNS couples	incompatible couples	couples A1	couples A2	couples B1	couples B2

Compatibility Summary

Id	Name	Kind	Adm	f (MHz)	Runway az. (°)	DOC (km)	h a.g.l. (m)	Incompatible	A1	A2	B1	B2
1	RN-ILS	ILS	D	108.1	90	NA	5	TRUE	TRUE	TRUE	TRUE	TRUE
2	RN-VOR-HI	VOR	HNG	108.05	NA	100	10	FALSE	FALSE	FALSE	FALSE	FALSE

Reading the results

1. **Compatibility Summary** — The ARNS stations with **Is Affected = TRUE** need attention
2. **Results per BC Station** — Which BC stations interfere, and with which types
3. **Interference Details** — Where (test points), by how much (margin), and which stations form the IM product
4. **Map** — Locate the test points and the stations involved

Margin

level − protection criterion

> 0 dB

at one test point: the protection criterion is exceeded, the ARNS station is affected

The GAM deliberately use conservative assumptions. A positive margin should trigger further examination. It does not identify harmful interference

Exercise outline

1. Build the ILS/VOR file of the ARNS station at the airport with the form (stations in the table)
2. Prepare the notice (T01) of the FM station to examine, as for the other GE84 tools
3. Submit a calculation: ARNS Receiver **ICAO Annex 10 1998**, FM BC Stations **Notice File**, Consider Tip
4. Check the input with **Preview on map**, then submit
5. Are the ILS / VOR affected? By which types? At which test points?
6. Download the **PDF report**

PARAMETER	ILS1	VOR1
Longitude (°)	6.089339	6.132207
Latitude (°)	46.224741	46.253914
Antenna height (m)	10	8
Frequency (MHz)	108.10	108.05
Bearing to approach (°T)	40	–
DOC range (km)	–	110

FM station of the exercise:
GE84-radionav-T01-exercise.txt

Recap

Method

SM.1009-1 GAM:

A1, A2, B1, B2 margins at the test points of each ILS / VOR

Input

ILS/VOR file (or the form) + a notice file or GE84 SS Part A requirements

Check

Preview the station geometry on map before submission

Results

Summary → BC stations → details per test point → map, PDF report

Thank you



Questions

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