User Guide

Equivalent Power Flux-Density Limits Validation Software Test Version

BR ITU, January 2019

User Guide Version 2.0

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1 INTRODUCTION

Resolution **85 (WRC-03)** deals with the application of Article 22 of the Radio Regulations to the protection of geostationary fixed-satellite service and broadcasting-satellite service networks from non-geostationary fixed-satellite service systems.

Resolution 85 (WRC-03) requires the Bureau to examine if the frequency assignments to:

a) FSS non-GSO satellite systems comply with the EPFD limits contained in Tables **22-1A**, **22-1B**, **22-1C**, **22-1D**, **22-1E**, **22-2** and **22-3** of RR Article **22**;

b) specific large earth station (under certain conditions) requires coordination under RR No. **9.7A** with respect to any existing non-GSO satellite systems using the coordination triggers in RR Appendix **5**; or

c) FSS non-GSO satellite systems requires coordination under RR No. **9.7B** with respect to any large earth station (under certain conditions) using the coordination triggers in RR Appendix **5**.

Application of these provisions is based of verification of the EPFD produced by non-GSO satellite systems.

2 BACKGROUND FOR EPFD VALIDATION SOFTWARE TEST VERSION

This EPFD Validation Test package can be used by administrations to evaluate their filings with respect to the compliance with Article 22 EPFD limits and Nos. 9.7A/9.7B with respect to the non-geostationary satellites systems and/or prepare required data to be used for regulatory examination.

This package includes GIBC module to be used as an interface to launch EPFD-validation, two implementations of EPFD validation software, two test cases and this user guide.

2.1 Technical Approach

The EPFD engine is integrated into the ITU BR's software so it can be run as part of the checks on a filed network. The architecture is shown in the figure below:



Figure 1: Software Architecture

2.2 Application of current EPFD Validation Software

EPFD validation software has been developed in accordance with Recommendation ITU-R S. 1503-2.

In a previous phase of development, a pair of implementations were developed that implemented the algorithm in S.1503-1.

The key changes between Recommendation ITU-R S.1503-1 and the revision in S.1503-2 were as follows:

Worst Case Geometry

• New WCG(down) algorithm

- New WCG(up) algorithm
- New WCG(IS) algorithm

Data Read Updates

- Read additional parameters from SRS
- Ensure match process to convert SRS database fields into orbit parameters
- Ensure can read new format of PFD and EIRP masks
- Ensure can read specific ES locations from SRS

Calculation Engine Updates

- Introduce ability to have ES EIRP masks vary by latitude
- Introduce ability to have satellite EIRP mask vary by latitude
- Introduce ability to handle PFD / EIRP mask bandwidth calculations
- Introduce ability to use specific ESs
- Updated algorithm for deployment of ES by density
- Other updates to the algorithm including selection of non-GSO satellite for EPFD(up)
- Set orbit model for equatorial non-GSO networks
- Ensure able to handle non-GSO systems using elliptical orbits
- Define resolution for alpha calculation
- Time step calculation update
- Run duration calculation update

These represented significant modifications, in particular the worst case geometry (WCG) was a highly complex algorithm involving separate procedures for different types of constellation.

The following five sets of systems were the basis for the testing and development:

| Туре | Orbit shape | Equatorial ? | Repeating ? | ES locations |
|------|------------------------|--------------|-------------|---------------------------|
| А | Circular | No | Yes | Typical (via density) |
| В | Circular | No | No | Typical (via density) |
| С | Circular | Yes | n/a | Typical (via density) |
| D | Elliptical | No | No | n/a |
| Е | Elliptical | No | Yes | Typical (via density) |
| F | Polar Limited Coverage | No | Yes | Specific (exact location) |

Table 1: Test Cases considered under development

3 INPUT DATA USED IN THE PACKAGE

EPFD Validation Package is supplied with the test SRS database containing two non-geostationary networks and a number of very large earth station to run all types of examinations including Article 22, 9.7A, 9.7B.

It should be noted that the test-data contained in the package may not correspond to the data currently contained in SRS-database.

3.1 System Requirements

EPFD Validation Software Test Version should run on most newer PCs but the following table represents what is considered to be the minimum and recommended system specifications.

| | Minimum | |
|------------------|--------------------------------|--|
| CPU | 2.0+ GHz Dual-Core | |
| RAM | 2 GB | |
| Operating System | Microsoft Windows Vista/7/8/10 | |
| Hard Disk Space | 500 MB | |

Recommended Intel Core i7+ 8+ GB Microsoft Windows 7 64 Bit 500+ MB

You will require "Administrator" privileges to install **EPFD Validation Software Test Version** and either "Standard User" or "Administrator" privileges to run GIBC and EPFD Tools.

3.2 Contents of the package and installation

The test-package contains:

- 1. Radiocommunication Bureau **GIBC** program containing an interface to EPFD Validation.
- 2. Data validation and manipulation tool EPFDPrepare
- 3. Results visualisation tool EPFDResultsView
- 4. Two separate EPFD Validation programs.

GIBC program is used by administrations and the Bureau to conduct technical/regulatory examinations of the satellite networks and/or earth stations. This includes but not limited to PFD calculation, coordination requirements examination, earth station AP7 contours calculation etc.

In order to install the package the following procedure should be followed:

1. Download **epfdpackage.exe** from the web-page:

http://www.itu.int/ITU-R/go/space-epfd/en

- 2. Run **epfdpackage.exe** to extract contents and start global setup program. Follow setup instructions.
- 3. Global setup will run individual installations of Transfinite S1503-2 Analysis, Agenium EPFDvalidation Tool and GIBC. All three are required for the proper software functioning. Please note the location of installed executable files of Agenium EPFD and Transfinite S1503-2 Analysis. This may need to be indicated in GIBC interface.
- Before running installation of Transfinite S1503-2 Analysis and Agenium EPFDvalidation Tool, please make sure that previous versions are uninstalled first.
 Go to Start -> Control Panel -> Program and Features -> Uninstall EPFDvalidation and Uninstall S1503-2 Analysis 5.XX.XX
- 5. Depending the version of the Windows Operating System, by default, EPFD tools are installed into the following folders.

For Agenium EPFD the default location is:

Running on **32 bit** Windows c:\Program Files\Agenium\EPFDvalidation\EPFDvalidation.exe Running on **64 bit** Windows c:\Program Files (x86)\Agenium\EPFDvalidation\EPFDvalidation.exe

For Transfinite S1503-2 Analysis the default location is:

Running on **32 bit** Windows – c:\Program Files\S1503_2Analysis\Program\S1503_2.exe Running on **64 bit** Windows – c:\Program Files (x86)\S1503_2Analysis\Program\S1503_2.exe

6. Step-by-step installation:

Select installation modules:

| EPFD Validation Package - InstallShield Wizard | | | | | |
|--|--|--|--|--|--|
| Select Applications | | | | | |
| | Select Applications to Install GIBC Agenium Transfinite | | | | |
| | Select All Clear All | | | | |
| InstallShield | < Back Next > Cancel | | | | |

Figure 2: Selecting modules to install



Advance to GIBC installation:

Figure 3: Install GIBC

Advance to Agenium EPFDvalidation setup:

| 閿 | EPFDvalidation | _ 🗆 X |
|---|---|-------------------------|
| Select Installation Fold | ler | Agenium |
| The installer will install EPFD validation | to the following folder. | |
| To install in this folder, click "Next". To | install to a different folder, enter it b | elow or click "Browse". |
| <u>F</u> older: | | |
| C:\Program Files (x86)\Agenium\EF | PFD validation\ | Browse |
| | | Disk Cost |
| Install EPFDvalidation for yourself, or | for anyone who uses this computer | r. |
| ○ <u>E</u> veryone | | |
| ● Just <u>m</u> e | | |
| | Cancel < <u>B</u> ac | k <u>N</u> ext > |

Figure 4: Install Agenium EPFDvalidation

Advance to Transfinite S1503-2 Analysis setup:

| B | Setup - S1503-2 Analysis 📃 🗖 🗙 |
|---|---|
| | Ready to Install Setup is now ready to begin installing S1503-2 Analysis on your computer. |
| | Click Install to continue with the installation. |
| | Install Cancel |

Figure 5: Install Transfinite S1503-2 Analysis

7. After the setup is finished, the following instruments could be located on the client machine:

C:\BR_SOFT\EPFDTest

This folder contains the following:

| EPFD_Test_Data.mdb | - | test SRS-data. |
|--------------------|---|----------------|
|--------------------|---|----------------|

EPFD_Test_Masks.mdb - PFD/EIRP mask data packed in database.

C:\BR_SOFT\EPFD

This folder contains the following:

| EPFD_limits_RES85.mdb | - | EPFD applicab | Limits le regulato | Database ory limits. | containing | information | on |
|-----------------------|----------|---|---------------------------|---------------------------------|-------------------|-------------------------------|------|
| EPFDPrepare.exe | - | Data validation and manipulation tool EPFDPrepare is launche through GIBC or could be launched as stand-alone tool from Sta Menu: | | | | ched Start | |
| | Start -> | Program | ns -> BR Sp | ace Applicati | ons -> GIBC -> | EPFDPrepare | |
| EPFDResultsView.exe | - | Results v or could | visualisatic be launch | on tool EPFDRe ed as stand-a | esultsView is lau | unched through Start Menu. | GIBC |

Start -> Programs -> BR Space Applications -> GIBC -> EPFDResultsView

8. Agenium EPFDvalidation tool and Transfinite S1503-2 Analysis can be run individually without using common GIBC interface. For the information on user interface of these tools please refer to their respective manuals:

For Agenium EPFDvalidation Tool:

c:\Program Files\Agenium\EPFDvalidation\Documents\UserManual.pdf

or

c:\Program Files (x86)\Agenium\EPFDvalidation\Documents\UserManual.pdf

For Transfinite S1503_2 Analysis:

c:\Program Files\S1503_2Analysis\Program\S1503_2_Software_Installation_and_User_Guide.pdf Or

c:\Program Files (x86)\S1503_2Analysis\Program\S1503_2_Software_Installation_and_User_Guide.pdf

4 RUNNING EPFD VALIDATION PACKAGE

Run GIBC: Start -> Programs -> BR Space Applications -> GIBC -> GIBC

Switch to tab EPFD to open the main interface of EPFD Validation Package. All the tools can be launched from here.

| | GIBC SNS V8 - Graphical Interface for Batch Calculations – 🗌 🗙 | A. Run FPFDPrenare to |
|---|--|-----------------------|
| | Appendix 8 PFD (terrestrial serv.) PFD (space serv.) Appendix 7 | enter test SRS-data |
| Selection of the notice | Appendix 30B Appendix 30 30A EPFD Power Control Tools / Options | and mask data |
| under examination and | Step 1.Prepare and validate SRS and Masks data | locations and or |
| regulatory examination | Masks: C:\br_soft\EPFD\Test\EPFD_Test_Masks.mdb | prepare the data for |
| туре | SRS: C:\br_soft\EPFD\Test\EPFD_Test_Data.mdb | examination |
| | EPFDPrepare | |
| | Step 2. Analysis | C1 Different ontions |
| | National Jackwine BB 22 Hard Limits | for EPED validation |
| | | |
| | Full WCG Down Check Select Limits Agenium | |
| | Use Dual Timestep Timestep TS1 | C2. To run analysis |
| | | using either software |
| | Message | package |
| D Different ontions to | | |
| access the results | < > | |
| | Results | |
| | | |
| | Open database Open folder View results | |
| Init. Setup location of | - Software location and EPED limits path | |
| EPFD Tools and limits | Transfinite:C:\Program Files (x86)\S1503 2Analysis\Program\S1503 2.exe | |
| database | | |
| | Agenium: C:\Program Files | |
| | | |
| | | |
| | EPED Manual | |
| | | |
| | EXIT Help | |
| | | |

Figure 6: GIBC EPFD Start Screen

Setting up options

Before running any examination, all the options indicated in the block **Init** needs to be properly set:

- Setup location to EPFD Tools executable *EPFDvalidation.exe* for Agenium, *S1503_2.exe* for Transfinite, if needed.
- Setup location EPFD Limits database.

Selecting Input Databases

Next step is to select input databases containing:

- PFD/EIRP mask data stored in MS-Access MDB format
- Test SRS-Data

Press EPFDPrepare button. EPFDPrepare will launch:

| EPFD Data Preparation | | | | | | | |
|--|--|--|--|--|--|--|--|
| In this dialog you can either select the databases containing the data for EPFD examination or prepare the Appendix 4 data elements required for EPFD examination of the filing or create and/or validate new databases | | | | | | | |
| Please select the databases required for examination Select the databases for examination | | | | | | | |
| Select the database with the masks | | | | | | | |
| | | | | | | | |
| Select SRS database with non-gso filing for examination | | | | | | | |
| Retum to GIBC | | | | | | | |
| Prepare the Appendix 4 data elements required for EPFD examination | | | | | | | |
| 1. Create Masks Database | | | | | | | |
| PFD/EIRP Mask Operations | | | | | | | |
| 2. Create SRS Database Prepare SRS Data | | | | | | | |
| Close <u>Support</u> | | | | | | | |

Figure 7: EPFDPrepare Start Screen

Select required databases and press *Return to GIBC*:

| EPFD Data Preparation | | | | | | |
|--|--|--|--|--|--|--|
| In this dialog you can either select the databases containing the data for EPFD examination or prepare the Appendix 4 data elements required for EPFD examination of the filing or create and/or validate new databases | | | | | | |
| Please select the databases required for examination | | | | | | |
| Select the databases for examination | | | | | | |
| Select the database with the masks | | | | | | |
| C:\BR_SOFT\EPFDTest\EPFD_Test_Masks.mdb | | | | | | |
| Select SRS database with non-gso filing for examination | | | | | | |
| C:\BR_SOFT\EPFDTest\EPFD_Test_Data.mdb | | | | | | |
| Return to GIBC | | | | | | |
| Prepare the Appendix 4 data elements required for EPFD examination | | | | | | |
| 1. Create Masks Database | | | | | | |
| PFD/EIRP Mask Operations | | | | | | |
| 2. Create SRS Database Prepare SRS Data | | | | | | |
| | | | | | | |
| Close <u>Support</u> | | | | | | |

Figure 8: EPFDPrepare database selection dialog

For other functions of *EPFDPrepare* see section **5** below.

Selecting Scenario

Examination scenario can be chosen in block B.

- For Article 22 and No. 9.7B examination the following notices could be examined using testdatabase:
 - **1**01
 - 102
- For No. 9.7A examination the following notices (very large earth stations) could be indicated:

| ntc_id | stn_name | ntc_id | stn_name |
|----------|-------------|-----------|-------------------|
| 96520567 | JDFPG-A3 | 100520518 | BUCKLEY1-KA2 |
| 96520568 | JDFPG-A4 | 100520519 | BUCKLEY2-KA2 |
| 96520569 | JDFPG-A5 | 100520527 | DCEETA-KH2 |
| 96520570 | JDFPG-A6 | 100520533 | DCEETA-KA2 |
| 96520571 | BUCKLEY1-W1 | 102520593 | SPECIFIC UK KU-2B |

| ntc_id | stn_name | | ntc_id | stn_name |
|----------|-----------------|---|-----------|-------------------|
| 96520572 | BUCKLEY1-W2 | | 102520594 | SPECIFIC UK KU-1B |
| 96520573 | BUCKLEY2-W1 | | 107520322 | JDFPG-4BKA |
| 96520574 | BUCKLEY2-W2 | | 107520323 | JDFPG-4BKU |
| 96520575 | DCEETA-E1 | | 108520079 | NHTS-A1 |
| 96520576 | DCEETA-E2 | | 108520080 | KAU-W1 |
| 96520577 | DCEETA-E3 | | 108520081 | KAU-W2 |
| 96520578 | DCEETA-E4 | | 108520082 | FTIRWIN-W1 |
| 96520579 | DCEETA-W1 | | 108520083 | FTIRWIN-W2 |
| 96520580 | MENWITH HILL-A1 | | 108520084 | NHTS-E1 |
| 96520581 | MENWITH HILL-A2 | | 108520085 | NHTS-E2 |
| 96520582 | MENWITH HILL-E1 | | 108520086 | NHTS-E3 |
| 96520583 | MENWITH HILL-E2 | | 108520087 | NHTS-E4 |
| 96520584 | MENWITH HILL-E3 | | 108520088 | NHTS-W1 |
| 96520585 | MENWITH HILL-E4 | | 108520089 | NHTS-W2 |
| 96520586 | DCEETA-W2 | | 108520090 | NHTS-H2 |
| 99520563 | JDFPG-1A | | 99520566 | MENWITH HILL-2A |
| 99520564 | JDFPG-2A |] | 99520567 | MENWITH HILL-1A |
| 99520565 | JDFPG-3A | | | |

Selecting additional options

Setup additional options for examination in block B1.

- Use Dual Timestep option to improve simulation performance (see Section 4.7, Part D, ITU-R Recommendation S.1503-2).
- Full WCG Down Check. The Worst-case geometry on downlink (WCG Down) calculation can take a significant amount of time to complete. To increase calculation performance, by default, the latitude step size of 1 degree will be used, if it less than PFD mask step size.
- Select Limits option to preselect Article 22 limits, which are to be examined.
- *Timestep* Normal or TS1. Use TS1 to reduce simulation time steps.

Running examination

After everything is ready, press 'Agenium' or 'Transfinite' in block C2 to run corresponding EPFD Tool.

Calculations are started automatically and once EPFD validation finishes, it may be required to close the dialog by pressing 'Ok' or 'Close' in EPFD validation tools dialog window.

| Appendix 8 PFD (terrestrial serv.) PFD (space serv.) Appendix 7 Appendix 30B Appendix 30 30A EPFD Power Control Tools / Options Step 1.Prepare and validate SRS and Masks data Masks: C:\br_soft\EPFD\Test\EPFD_Test_Masks.mdb SRS: C:\br_soft\EPFD\Test\EPFD_Test_Data.mdb SRS: C:\br_soft\EPFD\Test\EPFD_Test_Data.mdb EPFDPrepare Step 2. Analysis | PFD (terrestrial serv.) PFD (space serv.) Appendix 7 Appendix 30 30A EPFD Power Control Tools / Options and validate SRS and Masks data ft\EPFD\Test\EPFD_Test_Masks.mdb ft\EPFD\Test\EPFD_Test_Data.mdb EPFDPrepare |
|--|---|
| Step 1.Prepare and validate SRS and Masks data Masks: C:\br_soft\EPFD\Test\EPFD_Test_Masks.mdb SRS: C:\br_soft\EPFD\Test\EPFD_Test_Data.mdb EPFDPrepare Step 2. Analysis Notice Id 101 Analysis RR.22 Hard Limits Full WCG Down Check Image Select Limits Huse Dual Timestep Timestep Message Transfinite Message Open database Open database Open folder View results Software location and EPFD limits path Transfinite: C:\Program Files (x86)\S1503_2Analysis\Program\S1503_2.exe Agenium: C:\Program Files (x86)\Agenium\EPFDValidation.exe Limits DB: C:\br_soft\EPFD\EPFD_limits_RES85.mdb | and validate SRS and Masks data oft\EPFD\Test\EPFD_Test_Masks.mdb oft\EPFD\Test\EPFD_Test_Data.mdb EPFDPrepare |
| Masks: C:\br_soft\EPFD\Test\EPFD_Test_Masks.mdb SRS: C:\br_soft\EPFD\Test\EPFD_Test_Data.mdb Step 2. Analysis Image: Comparison of the | ht\EPFD\Test\EPFD_Test_Masks.mdb ht\EPFD\Test\EPFD_Test_Data.mdb EPFDPrepare |
| SRS: C:\br_soft\EPFD\Test\EPFD_Test_Data.mdb EPFDPrepare Step 2. Analysis Notice Id 101 Analysis RR.22 Hard Limits Agenium I Use Dual Timestep Timestep TS1 Agenium Message < Results Deen database Deen folder View results Software location and EPFD limits path Transfinite: C:\Program Files (x86)\S1503_2Analysis\Program\S1503_2.exe Agenium: C:\Program Files (x86)\Agenium\EPFD\alidation \EPFD\alidation .exe Limits DB: C:\br_soft\EPFD\EPFD_limits_RES85.mdb EPFD Manual | oft\EPFD\Test\EPFD_Test_Data.mdb EPFDPrepare |
| EPFDPrepare Step 2. Analysis Notice Id 101 Analysis RR.22 Hard Limits Full WCG Down Check Select Limits Use Dual Timestep Timestep Timestep TS1 Message Pen database Open database Open folder View results Software location and EPFD limits path Transfinite: C:\Program Files (x86)\S1503_2Analysis\Program\S1503_2.exe Agenium: C:\Program Files (x86)\Agenium\EPFDValidation \EPFDvalidation.exe Limits DB: C:\br_soft\EPFD\EPFD_limits_RES85.mdb | EPFDPrepare |
| Step 2. Analysis Notice Id 101 Analysis Result Message Results Open database Open folder View results Software location and EPFD limits path Transfinite: C:\Program Files (x86)\S1503_2Analysis\Program\S1503_2.exe Agenium: C:\Program Files (x86)\Agenium\EPFDValidation\EPFDvalidation.exe Limits DB: C:\br_soft\EPFD\EPFD_limits_RES85.mdb | |
| Notice Id 101 Analysis RR.22 Hard Limits Full WCG Down Check ✓ Select Limits Agenium Use Dual Timestep Timestep Ts1 Transfinite Message ✓ ✓ Open database Open folder View results Software location and EPFD limits path Transfinite: C:\Program Files (x86)\S1503_2Analysis\Program\S1503_2.exe Agenium: C:\Program Files (x86)\S1503_2Analysis\Program\S1503_2.exe Agenium: C:\Program Files (x86)\S1503_2Analysis\Program\S1503_2.exe Imits DB: C:\br_soft\EPFD\EPFD_limits_RES85.mdb | |
| Full WCG Down Check Select Limits Agenium Use Dual Timestep Timestep Ts1 Transfinite Message Image: | Analysis RR.22 Hard Limits - |
| Use Dual Timestep Timestep TS1 Transfinite Message > Results > Open database Open folder View results Software location and EPFD limits path Transfinite:C:\Program Files (x86)\S1503_2Analysis\Program\S1503_2.exe Agenium: C:\Program Files (x86)\Agenium\EPFDValidation\EPFDvalidation.exe Limits DB: C:\br_soft\EPFD_EPFD_limits_RES85.mdb | wn Check 🔽 Select Limits Agenium |
| Message Results Open database Open folder View results Software location and EPFD limits path Transfinite: C:\Program Files (x86)\S1503_2Analysis\Program\S1503_2.exe Agenium: C:\Program Files (x86)\Agenium\EPFDValidation\EPFDvalidation.exe Limits DB: C:\br_soft\EPFD\EPFD_limits_RES85.mdb EPFD Manual | nestep Timestep TS1 |
| > Results Open database Open folder View results Software location and EPFD limits path Transfinite: C:\Program Files (x86)\S1503_2Analysis\Program\S1503_2.exe Agenium: C:\Program Files (x86)\Agenium\EPFDValidation\EPFDvalidation.exe Limits DB: C:\br_soft\EPFD\EPFD_limits_RES85.mdb | |
| > Results Open database Open folder View results Software location and EPFD limits path Transfinite: C:\Program Files (x86)\S1503_2Analysis\Program\S1503_2.exe Agenium: C:\Program Files (x86)\S1503_2Analysis\Program\S1503_2.exe Agenium: C:\Program Files (x86)\Agenium\EPFDValidation\EPFDvalidation.exe Limits DB: C:\br_soft\EPFD\EPFD_limits_RES85.mdb | |
| Results Open database Open folder View results Software location and EPFD limits path Transfinite: C:\Program Files (x86)\S1503_2Analysis\Program\S1503_2.exe Agenium: C:\Program Files (x86)\Agenium\EPFDValidation\EPFDvalidation.exe Limits DB: C:\br_soft\EPFD\EPFD_limits_RES85.mdb EPFD Manual | |
| Results Open database Open folder View results Software location and EPFD limits path Transfinite: C:\Program Files (x86)\S1503_2Analysis\Program\S1503_2.exe Agenium: C:\Program Files (x86)\S1503_2Analysis\Program\S1503_2.exe Agenium: C:\Program Files (x86)\Agenium\EPFDValidation\EPFDvalidation.exe Limits DB: C:\br_soft\EPFD\EPFD_limits_RES85.mdb | / |
| Open database Open folder View results Software location and EPFD limits path | |
| Open database Open folder View results Software location and EPFD limits path | |
| Software location and EPFD limits path Transfinite:C:\Program Files (x86)\S1503_2Analysis\Program\S1503_2.exe Agenium: C:\Program Files (x86)\Agenium\EPFDValidation\EPFDvalidation.exe Limits DB: C:\br_soft\EPFD\EPFD_limits_RES85.mdb EPFD Manual | Open database Open folder View results |
| Transfinite:C:\Program Files (x86)\S1503_2Analysis\Program\S1503_2.exe Agenium: C:\Program Files (x86)\Agenium\EPFDValidation\EPFDvalidation.exe Limits DB: C:\br_soft\EPFD\EPFD_limits_RES85.mdb EPFD Manual | n and EPFD limits path |
| Agenium: C:\Program Files (x86)\Agenium\EPFDValidation\EPFDvalidation.exe Limits DB: C:\br_soft\EPFD\EPFD_limits_RES85.mdb EPFD Manual | ogram Files (x86)\S1503_2Analysis\Program\S1503_2.exe |
| Limits DB: C:\br_soft\EPFD\EPFD_limits_RES85.mdb | ogram Files |
| EPFD Manual | _soft\EPFD\EPFD_limits_RES85.mdb |
| | EPFD Manual |
| <u>E</u> XIT Help | <u>E</u> XIT Help |
| S1503_2: A22, ntc_id = 101 (Skybridge) | 51503_2: A22, ntc_id = 101 (Skybridge) |
| | |
| I Runs Complete | |
| esult = FAIL | |
| | |
| Close | |

Figure 9: Start and completion of examination

For each examination run, GIBC generates results database located in the following folder:

C:\BR_TEX_RESULTS\EPFD\[NOTICE_ID]\[DATE_TIME_STAMP]\EPFDRESULTS.MDB

Results database contains the definition of the runs as well as the results returned by the two software tools.

Description of the format is contained in Annex 1.

Viewing the results

After the analysis is finished, user is presented with several options to review the results:

- 1. Open the database containing the results
- 2. Open a folder containing a database with the results.
- 3. Launch *EPFDResultsView* utility to review results in details by clicking View results in block **D**.

Viewing the results in EPFDResultsView utility

Once the utility is launched through GIBC interface, a list of results corresponding to each of the applicable limits is presented.

For Article 22 examination, every results in this list may be characterized by direction of transmission, service, frequency band, reference GSO earth station antenna pattern, antenna diameter and reference bandwidth.

Each of the results can be reviewed to check **Pass/Fail** status, check cumulative distribution function or details of examination.

Pass/Fail status is established both for Article 22 calculations and 9.7A/9.7B coordination triggers. For Article 22 **'Fail'** status means that EPFD hard-limits are exceeded; in 9.7A/9.7B examination it would indicate that there is an affected non-GSO network or earth station.

| V EPFD Results View | _ D X |
|--|---------------|
| Select input results View results | |
| Select results database C:\BR_TEX_RESULTS\EPFD\101\160525132344\EPFDRESULT Clear All Added | |
| Select Result to Display (use 'Ctrl'/Shift' to make multiple selection) | |
| B-At22 | |
| in 101 | |
| ⊞ -epfd1, FSS, F=12.5 GHz, Ant S.672, Ls -20, 4°, per 40 kHz | |
| ⊞ -epfd1, FSS, F=17.3 GHz, Ant S.672, Ls -20, 4°, per 40 kHz | |
| ⊞ - epfd1, FSS, F=27.5 GHz, Ant S.672, Ls -10, 1.55°, per 40 kHz | |
| ⊞ - epfd1, FSS, F=29.5 GHz, Ant S.672, Ls -10, 1.55°, per 40 kHz | |
| ⊞ - epfd1, FSS, F=10.7 GHz, Ant S.1428, d=.6 m, per 40 kHz | |
| ⊞ -epfdi, FSS, F=10.7 GHz, Ant S.1428, d=1.2 m, per 40 kHz | |
| ⊞ - epfd1, FSS, F=10.7 GHz, Ant S.1428, d=3 m, per 40 kHz | |
| ⊞ - epfd1, FSS, F=10.7 GHz, Ant S.1428, d=10 m, per 40 kHz | |
| ⊞ - epfd1, FSS, F=17.8 GHz, Ant S.1428, d=1 m, per 40 kHz | |
| ⊞ - epfd1, FSS, F=17.8 GHz, Ant S.1428, d=2 m, per 40 kHz | |
| i∄ -epfd1, FSS, F=17.8 GHz, Ant S.1428, d=5 m, per 40 kHz | |
| i∄ -epfd1, FSS, F=17.8 GHz, Ant S.1428, d=1 m, per 1000 kHz | |
| ⊞ - epfd1, FSS, F=17.8 GHz, Ant S.1428, d=2 m, per 1000 kHz | |
| ⊞ -epfd⊥, FSS, F=17.8 GHz, Ant S.1428, d=5 m, per 1000 kHz | |
| ⊞ - epfd1, FSS, F=19.7 GHz, Ant S.1428, d=.7 m, per 40 kHz | |
| ⊞ - epfd1, FSS, F=19.7 GHz, Ant S.1428, d=.9 m, per 40 kHz | |
| i∄ -epfd1, FSS, F=19.7 GHz, Ant S.1428, d=2.5 m, per 40 kHz | |
| ⊞ -epfd1, FSS, F=19.7 GHz, Ant S.1428, d=5 m, per 40 kHz | |
| i∄ ∼epfd1, FSS, F=19.7 GHz, Ant S.1428, d=.7 m, per 1000 kHz | |
| ⊞ -epfd1, FSS, F=19.7 GHz, Ant S.1428, d=.9 m, per 1000 kHz | |
| ⊡ - epfd↓, FSS, F=19.7 GHz, Ant S.1428, d=2.5 m, per 1000 kHz | |
| ⊞ -epfd1, FSS, F=19.7 GHz, Ant S.1428, d=5 m, per 1000 kHz | |
| | |
| ⊞ - epfd↓, BSS, F=11.7 GHz, Ant BO.1443, d=.45 m, per 40 kHz | |
| ⊞ -epfd⊥, BSS, F=11.7 GHz, Ant BO.1443, d=.6 m, per 40 kHz | |
| ⊞ -epfd1, BSS, F=11.7 GHz, Ant BO.1443, d=.9 m, per 40 kHz | |
| i∄ -epfd1, BSS, F=11.7 GHz, Ant BO.1443, d=1.2 m, per 40 kHz | |
| i∄ -epfd1, BSS, F=11.7 GHz, Ant BO.1443, d=1.8 m, per 40 kHz | |
| i∄⊢epfd1, BSS, F=11.7 GHz, Ant BO.1443, d=2.4 m, per 40 kHz | |
| i∄ ⊳epfd1, BSS, F=11.7 GHz, Ant BO.1443, d=3 m, per 40 kHz | |
| i∄⊢epfd+, FSS, F=10.7 GHz, Ant S.672, Ls -20, 4°, per 40 kHz | |
| ⊞epfd⇔, FSS, F=17.8 GHz, Ant S.672, Ls -20, 4°, per 40 kHz | |
| | - to down the |
| Ad Seit | cted results |
| | |
| | |

Figure 10: Selecting results review

To get more detailed overview, one or several results under the interest can be selected. To select multiple results make a selection of different entries using Control key and clicking each of the results. To proceed with the review after the selection, press the button **Add Selected results** and navigate to **View results** tab. The dialog on **View results** tab allows more detailed examination of each of the results.



Figure 11: Displaying resulting CCDF

Complementary Cumulative distribution function¹ (CCDF) for each of the results could be plotted individually or combined with other results.

EPFDResultsView can be launched separately from Start Menu.

It is possible to open results files one by one and select the results of different runs and then compare the results coming from different databases by plotting them together. This could be used to compare the results obtained using two different EPFD validation tools.

¹ CCDF computes the power complementary cumulative distribution (CCDF) function from a time domain signal. The CCDF curve shows the amount of time a signal spends above the power level of the calculate signal, or equivalently, the probability that the signal power will be above the given power level.



Figure 12: Displaying resulting CCDF from two databases in comparison mode

Interface options:

- Checking 'Show legend' will display graphs legend.
- Double clicking a result on chart legend displays color selection dialog which can be used to change the color of result graph.
- Double clicking on any horizontal or vertical grid line displays color selection dialog which can be used to change the color of horizontal/vertical grid lines.
- If several results are plotted with different reference bandwidths, the X-axis title will display all the references bandwidths, e.g. EPFD, dBW/m²/40,1000 kHz.
- Data points can be viewed by hovering mouse along the result curve.
- Clicking and dragging the mouse in chart area would allow zoom in to specific chart region. To return to full view right click anywhere on chart.

5 DATA REQUIRED FOR EPFD VALIDATION

5.1 Data and Database Structure

Information on the fields in the SRS required by the algorithm in Rec. ITU-R S.1503-2 is given in Annex 2.

5.2 Submitted Data

A number of potential issues with data submitted in actual non-GSO filings are observed. These include:

- A.4.b.7.d.1: the type of zone (based on topocentric angle, satellite-based angle or other method for establishing the exclusion zone)
 - The option "other" is not implementable
 - When the field contains characters different from Y or N, no exclusion method is assumed in the software which corresponds to value Y for the method and 0 degrees for the exclusion angle.
- Lack of understanding of use of non-GSO ES average density and separation distance, as described in Section 5.3
- Fields were not always set for example elevation angle specified in some groups but left undefined in others
- Repetition between groups, for example specifying the PFD mask multiple times, resulting in multiple runs or requirement to filter out duplicates
- PFD masks submitted for ascending / descending nodes and by satellite longitude, neither of which is consistent with the format defined in Rec. S.1503-2
- Reference bandwidth not set in the PFD or EIRP masks.

5.3 Non-GSO ES Deployment

The use of *avg_dist* and *density* elements:

- density (ES_DENSITY) Average number of associated earth stations transmitting with overlapping frequencies per km² in a cell
- **avg_dist** (ES_DISTANCE) Average distance between co-frequency cells in kilometers

These are required for uplink EPFD analysis to calculate the number of earth stations be populated:

NUM_ES = ES_DISTANCE * ES_DISTANCE * ES_DENSITY

One issue raised was how these should be defined for the different cases of the access method being FDMA, TDMA or CDMA. In addition, there was the special case where there would only be a single ES within the field of view active on any specific frequency at any one time.

If the supplied ES_DISTANCE is zero then set NUM_ES = 1 and at Step 4 locate a single non_GSO ES at the boresight of the GSO satellite

The NUM_ES is typically 1 for TDMA and FDMA systems and for CDMA systems equal to the number of cofrequency ES all operating on the same frequency at the same time and location. The ES_DISTANCE relates to the smallest distance between co-frequency beams.

5.4 Multiple Non-GSO Orbit Parameters

Recommendation ITU-R S.1503-2 was developed on the basis of the non-GSO FSS system under evaluation having a single set of semi-major axis (a), orbit inclination angle (i) and eccentricity (e). These parameters were used to calculate the worst case geometry plus the time step and duration in addition to the orbit prediction in the EPFD calculations.

In particular, the {a, e, i} elements were used to derive run times such that the constellation would repeat and return to its original configuration. This ensured that the statistics were consistent and complete i.e. all configurations of the constellation were considered an equal number of times to avoid biases.

However with multiple {a, e, i} each sub-set is likely to have different repeat times and S.1503-2 does not include a methodology to calculate the appropriate run time and, where necessary, adjust the orbit model.

For networks having different non-homogenous orbits which are not to be used simultaneously earth stations with its own eirp-mask in the same frequency band, , it is recommended to define separate examination scenarios for each individual type orbit by creating several runs with only one type of orbit to be used.

5.5 Multiple Non-GSO ES EIRP Masks

Rec. ITU-R S.1503 was written on the basis of a single non-GSO ES EIRP mask per frequency band but it was noted during development that there was no reason that multiple non-GSO ES could not be filed and analysed by the verification software.

For networks having different earth stations with its own eirp-mask in the same frequency band, it is recommended to define separate examination scenarios for each individual eirp mask by creating several runs with only one type of eirp mask to be used.

5.6 Defining examination scenario

To run properly EPFD examination, it is important to establish correct relationship between frequency assignments groups and PFD/EIRP masks of the non-GSO filing under examination.

There are two tables in SNS structure establishing this link:

mask_Ink1 table establishes the link for transmitting space station PFD/EIRP mask and corresponding group of frequency assignments

| Data Item | Description |
|------------|---|
| grp_id | Unique identifier of the group |
| ntc_id | Unique identifier of the notice |
| mask_id | Unique identifier of the mask |
| orb_id | Sequence number of the orbital plane |
| | If -1 or empty applies to all orbital planes. |
| sat_orb_id | Satellite sequence number in the orbital plane |
| | If empty, applies to all the satellites in orbital plane. |

mask_Ink2 table establishes the link for transmitting earth station EIRP mask and corresponding group of frequency assignments

| Data Item | Description |
|------------|--|
| grp_id | Unique identifier of the group |
| seq_e_as | Sequence number of the associated earth station. |
| | -1 if mask applies to typical ES, otherwise equal to seq_no of specific ES in e_as_stn for given grp_id |
| ntc_id | Unique identifier of the notice |
| mask_id | Unique identifier of the mask |
| orb_id | Sequence number of the orbital plane |
| | If -1 or empty applies to all orbital planes. |
| sat_orb_id | Satellite sequence number in the orbital plane |
| | If empty applies to all the satellites in orbital plane. |

Each network could have several different combinations of frequency assignments and transmission characteristics.

Frequency assignments groups are defined in SNS group table and include combinations of one or several central frequencies, associated earth stations, emissions and power characteristics.

When it concerns Article 22 examination, each Article 22 limit cover specific band for which specific EPFD limit would apply.

It is common scenario when several frequency assignments, not necessarily overlapping with each other, could fall into the same limit band.

For example, Table 22-1B of Article 22 covers the whole 17.8-18.6 GHz band. If non-GSO filing has separate frequency assignments groups - group 1 (17.8-18.1 GHz), group 2 (18.1-18.3 GHz), group 3 (18.4-18.6 GHz), it is sufficient to run examination only for one group 1. And then use the results of this examination for group 2 and 3.

For, No. 9.7A and 9.7B, however, it is important to include into examination all non-repeating frequency band assignments to make sure all the affected stations/networks are identified.

Let's consider more complex scenario. In scenario described below, a network has several combinations of satellite footprint gain/earth station gain and assigned frequency.

| Satellite beam | Assigned Frequency Band | Associated Earth Station | Emission Power Spectral Density | GroupID |
|----------------|----------------------------|--------------------------|------------------------------------|---------|
| | | TYPE A (GAIN EX) | PSD_VALUE 1 | GROUP1 |
| | F1 - F2 | | PSD_VALUE 2 | GROUP2 |
| | | TYPE B (GAIN EY) | PSD_VALUE 1 | GROUP3 |
| | | | PSD_VALUE 2 | GROUP4 |
| TYPE SA | | TYPE A (GAIN EX) | PSD_VALUE 1 | GROUP5 |
| (GAIN SX) | F2 - F3 | | PSD_VALUE 2 | GROUP6 |
| | | TYPE B (GAIN EY) | PSD_VALUE 1 | GROUP7 |
| | | | PSD_VALUE 2 | GROUP8 |
| | | TYPE A (GAIN EX) | PSD_VALUE 1 | GROUP9 |
| | F1 - F2 | | PSD_VALUE 2 | GROUP10 |
| | | TYPE B (GAIN EY) | PSD_VALUE 1 | GROUP11 |
| | | | PSD_VALUE 2 | GROUP12 |
| TYPE SB | | TYPE A (GAIN EX) | PSD_VALUE 1 | GROUP13 |
| (GAIN SY) | F2 - F3 | | PSD_VALUE 2 | GROUP14 |
| | | TYPE B (GAIN EY) | PSD_VALUE 1 | GROUP15 |
| | | | PSD_VALUE 2 | GROUP16 |

For each of this combination different PFD/EIRP mask could be defined:

PFD MASK 1: Satellite beam **SA** – frequency band **F1-F2** - PSD Value **1**:

| Satellite beam | Assigned Frequency Band | Associated Earth Station | Emission Power Spectral Density | GroupID |
|-------------------|----------------------------|--------------------------|------------------------------------|---------|
| | | TYPE A (GAIN EX) | PSD_VALUE 1 | GROUP1 |
| TYPE SA (GAIN SX) | F1-F2 | | | |
| | | TYPE B (GAIN EY) | PSD_VALUE 1 | GROUP3 |
| | | | | |

Similarly, for other configurations mask links can be defined

PFD MASK 2: Satellite beam SA – frequency band F1-F2 - PSD Value 2

PFD MASK **3**: Satellite beam **SB** – frequency band **F1-F2** - PSD Value **1**

PFD MASK 4: Satellite beam **SB** – frequency band **F1-F2** - PSD Value **2**

Since all these mask are covering the same frequency band and to be transmitted at unknown time intervals, including them altogether into examination is not possible.

However, it would be possible to define several different runs to be executed separately.

Run 1. Only includes MASK 1 linked to group 1 or 3.

Run 2. Only includes MASK 2 linked to group 2 or 4.

Run 3. Only includes MASK 3 linked to group 9 or 11.

Run 4. Only includes MASK 4 linked to group 10 or 12.

For each of this run, it will be possible also to add groups selected in similar manner for the frequency band F2-F3 provided that F1-F2 and F2-F3 are not covering the same frequency band.

To achieve such separation of data, several ways could be considered:

- 1. Simplest approach is to split the filing into several filings each corresponding to its own examination scenario
- 2. To change the link in mask_lnk tables so it would only point to the groups to be run individually.

More complex situations would involve adding one more layer describing different orbital configurations when filing contains different type of orbits. Although there are several orbital constellations in the filing, only one of the satellite orbits will be subject to transmission.

For each run, only specific orbital planes can be extracted or alternatively indicated in mask_lnk tables.

EPFDPrepare allows both approaches to be taken. The user should favour most simple approach as seen from the perspective of particular network configuration.

It is highly recommended whenever possible to define PFD/EIRP mask which would cover all the possible scenarios and run examination only once for single frequency assignment group covering specific EPFD limit.

It should be mentioned, however, that there are exceptions, which allow application of several masks to one frequency assignments group or the limit:

- Limit contains two values of reference bandwidth (e.g. 40 and 1000 kHz). In this case, only mask for lowest reference bandwidth should be provided. When limit is calculated having higher reference bandwidth PFD-level will be adjusted to 1 MHz bandwidth.
- 2. Different PFD mask are applicable for different orbits and these different orbits are transmitting simultaneously. In this case, it is possible to indicate individual combinations of pfd masks and orbital planes for the frequency assignment group.

6 USING EPFDPREPARE

Non-GSO system may consist of very complex configurations which may include non-homogenous orbits, different combinations of transmission characteristics and earth stations parameters.

Moreover, existing SRS_ALL does not contain information which establishes the link between PFD/EIRP masks and associated frequency assignments, simply because PFD/EIRP-masks are submitted mostly after the publication of non-GSO system.

There are some other specific issues (see section 5.2) with already provided data which require its adjustment before running EPFD validation.

All these factors indicate that running EPFD validation using directly SRS_ALL database is not feasible, and it is of critical importance to make sure first that all necessary data elements are present and validated. For that purpose, a separate utility **EPFDPrepare** was created which would facilitate creation of custom examination scenarios.

Disclaimer: *EPFDPrepare* is not mandatory software to be used when preparing filing for submission to ITU. Its purpose purely to facilitate EPFD examination. All the elements (except mask tables) required for EPFD examination could be prepared using SpaceCap. However, *EPFDPrepare* would help to correctly establish the links between the masks and SRS data as well to provide validation of the elements required for EPFD examination.

EPFDPrepare can be launched from GIBC or executed separately through Start Menu.

| Starting EPFDPrepare from GIBC | | | | | |
|--|--|--|--|--|--|
| EPFD Data Preparation | | | | | |
| In this dialog you can either select the databases containing the data for EPFD examination or prepare the Appendix 4 data elements required for EPFD examination of the filing or create and/or validate new databases | | | | | |
| Please select the databases required for examination Select the databases for examination | | | | | |
| Select the database with the masks | | | | | |
| | | | | | |
| Select SRS database with non-gso filing for examination | | | | | |
| Return to GIBC | | | | | |
| Prepare the Appendix 4 data elements required for EPFD examination | | | | | |
| 1. Create Masks Database | | | | | |
| PFD/EIRP Mask Operations | | | | | |
| 2. Create SRS Database Prepare SRS Data | | | | | |
| Close <u>Support</u> | | | | | |

Figure 13: EPFDPrepare start screen

Preparing Mask Data

If mask database needs to be created, press PFD/EIRP Mask Operations to start Mask Data Dialog.

On this screen user can start creating new mask database or open existing one to continue manipulations with the mask data.

| Mask 🗸 Mask | | – 🗆 X | | |
|---|--|-----------------------------------|--|--|
| Mask database operations First select the database to work with. You can create a new database or open existing one | Mask operations Once the database is opened you can manipulate with existing masks in database or add new masks. | Other New ntc_id | | |
| New mask mdb file | Extract selected mask(s) from MDB Delete selected mask | Renumber ntc_id of selected masks | | |
| Open existing mask mdb file Save Changes | Store Mask(s) to MDB | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | Support | | |

Figure 14: Running mask operation dialog

Start by creating new mask database by pressing *New mask mdb file*.

| Mask Mask | | - 🗆 X |
|---|--|-----------------------------------|
| Mask database operations First select the database to work with. You can create a new database or open existing one | Mask operations Once the database is opened you can manipulate with existing masks in database or add new masks. | Other New ntc_id |
| New mask mdb file | Extract selected mask(s) from MDB Delete selected mask | Renumber ntc_id of selected masks |
| Open existing mask mdb file Save Changes | Store Mask(s) to MDB | |
| Notice ID Mask ID Satellite Name | Mask Type of PFD Mask | |
| | Result × | |
| | Done! | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | Support |

Figure 15: Creating new mask file database

Next step is to add XML-format mask to newly created database. Press Store Mask(s) to MDB.

In the following dialog user can add one or several XML-format masks.

| S | Ma | isks datab | ase | | | | x |
|--|------|---|--|--|--|--|--|
|) ← ③ ▼ ↑ 🎉 « System_C\$ (C:) → EPFDDemo → | NSKY | (▶ PFD M | asks | ~ ¢ | Search | PFD Masks | Q |
| Organize 🔻 New folder | | | | | | | |
| Organize New folder EPFDDemo KSKY ES EIRP Masks FD Masks SS EIRP Masks SS EIRP Masks KSOCache OPING PerfLogs Program Files Program Files Program Files SpaceCom_Comments | | Name PFD N PFD N | lask-Ka-17.8-1 lask-Ka-17.8-1 lask-Ka-17.8-1 lask-Ka-17.8-1 lask-Ka-17.8-1 lask-Ka-19.7-2 lask-Ka-19.7-2 lask-Ka-19.7-2 lask-Ka-19.7-2 lask-Ka-19.7-2 | 18.6GHz_Ori 18.6GHz_Ori 18.6GHz_Ori 18.6GHz_Ori 18.6GHz_Ori 20.2GHz_Ori 20.2GHz_Ori 20.2GHz_Ori 20.2GHz_Ori 20.2GHz_Ori 20.2GHz_Ori 20.2GHz_Ori | bit Type N bit Type N | BEE Date modified 19.05.2016 14:48 19.05.2016 14:49 | Type Type XML Fi XML Fi |
| SpaceCom_Comments_Demo SSCTools sysprep System Volume Information TOOLS File <u>n</u> ame: "PFD Mask-Ka-17.8-18.6 | | < rbit Type N1 | _40kHz.xml" " | III PFD Mask- | V XML n | nask files (*.xml) Ipen Ca | > v Incel |

Figure 16: Adding XML-format masks to the database

For each mask selected, the program will validate the mask and provide the list of identified issues with the mask.

| V | Store | Mask | | | x |
|---|--|--------------------|-------------|------------------|--------|
| File PFD Ma | sk-Ka-17.8-18.6GHz_Orbit Type N2_40kHz.xml Min frequency (MHz) | 17800 | | | |
| Type of mask | Space station PFD Max frequency (MHz) | 18600 | | | |
| Satellite name | NSKY Data Type | azimuth_elevation | | | |
| | | | | | |
| Mask validation re | sults | | | | |
| Severity | Message | | Line Number | Position in line | |
| ERROR | The 'b' attribute is invalid - The value '185.0' is invalid according to its o | latatype 'Decimal' | 2299 | 13 | |
| ERROR | The 'b' attribute is invalid - The value '190.0' is invalid according to its o | latatype 'Decimal' | 2361 | 13 | |
| ERROR | The 'b' attribute is invalid - The value '195.0' is invalid according to its o | latatype 'Decimal' | 2423 | 13 | |
| ERROR | The 'b' attribute is invalid - The value '200.0' is invalid according to its o | latatype 'Decimal' | 2485 | 13 | |
| ERROR | The 'b' attribute is invalid - The value '205.0' is invalid according to its o | latatype 'Decimal' | 2547 | 13 | |
| ERROR | The 'b' attribute is invalid - The value '210.0' is invalid according to its o | latatype 'Decimal' | 2609 | 13 | |
| ERROR | The 'b' attribute is invalid - The value '215.0' is invalid according to its o | latatype 'Decimal' | 2671 | 13 | |
| ERROR | The 'b' attribute is invalid - The value '220.0' is invalid according to its o | latatype 'Decimal' | 2733 | 13 | |
| ERROR | The 'b' attribute is invalid - The value '225.0' is invalid according to its o | latatype 'Decimal' | 2795 | 13 | |
| ERROR | The 'b' attribute is invalid - The value '230.0' is invalid according to its o | latatype 'Decimal' | 2857 | 13 | |
| ERROR | The 'b' attribute is invalid - The value '235.0' is invalid according to its o | latatype 'Decimal' | 2919 | 13 | |
| ERROR | The 'b' attribute is invalid - The value '240.0' is invalid according to its o | latatype 'Decimal' | 2981 | 13 | |
| ERROR | The 'b' attribute is invalid - The value '245.0' is invalid according to its o | latatype 'Decimal' | 3043 | 13 | |
| ERROR | The 'b' attribute is invalid - The value '250.0' is invalid according to its o | latatype 'Decimal' | 3105 | 13 | |
| ERROR | The 'b' attribute is invalid - The value '255.0' is invalid according to its o | latatype 'Decimal' | 3167 | 13 | |
| ERROR | The 'b' attribute is invalid - The value '260.0' is invalid according to its o | latatype 'Decimal' | 3229 | 13 | |
| ERROR | The 'b' attribute is invalid - The value '265.0' is invalid according to its o | latatype 'Decimal' | 3291 | 13 | |
| ERROR | The 'b' attribute is invalid - The value '270.0' is invalid according to its o | latatype 'Decimal' | 3353 | 13 | |
| ERROR | The 'b' attribute is invalid - The value '275.0' is invalid according to its o | latatype 'Decimal' | 3415 | 13 | |
| ERROR | The 'b' attribute is invalid - The value '280.0' is invalid according to its o | latatype 'Decimal' | 3477 | 13 | \sim |
| Confirm ntc_id Notice ID Mask ID Store | and mask_id and press 'Store' to store the mask [104 3 Cancel | | | | |
| | | | | | |

Figure 17: Mask validation dialog

Some basic information is also given for the mask to be added. If needed, mask Notice ID and Mask ID could be changed on the same screen. After the review of this information, press *Store* button.

If errors are present in the mask the user is presented with the following dialog.

| Confirmation |
|---|
| There is/are validation error(s) present. Are you sure want to store the mask in MDB. EPFD examination may not run correctly. |
| <u>Y</u> es <u>N</u> o |

Figure 18: Storing the masks

Also, if the mask with the same Notice ID and Mask ID is already present in the database, a confirmation is requested to overwrite the mask.





| sk database operations irst select the database to work with. You can reate a new database or open an existing one New mask mdb file | | | Mask operations Once the database existing masks in d | is opened you atabase or add | Other New ntc_id | | |
|---|---------------|-------------------|---|---------------------------------|---------------------|----------------------------------|--|
| | | | Extract selected mask(s) from MDB Delete selected mask | | | Renumber ntc_id of selected mask | |
| pen existing r | mask mdb file | Save | Changes | Store Mask(s) | to MDB | | |
| Notice ID | Mask ID | Satellite Name | Mask Type | Type of PFD Mask | | | |
| 104 | 2 | NSKY | Р | azimuth_elevation | | | |
| 104 | 4 | NSKY | P | azimuth_elevation | | | |
| 104 | 6 | NSKY | Р | azimuth_elevation | | | |
| 104 | 8 | NSKY | P | azimuth_elevation | | | |
| 104 | 10 | NSKY | P | azimuth_elevation | | | |
| 104 | 12 | NSKY | Р | azimuth_elevation | | | |
| 104 | 13 | NSKY | E | | | | |
| 104 | 14 | NSKY | E | | | | |
| 104 | 15 | NSKY | E | | | | |
| 104 | 16 | NSKY | E | | | | |

Figure 20: List of stored masks

After the masks are added they are displayed in the main window.

In this user interface, mask from the database could be deleted or extracted in XML-format from the database.

Once all masks operations are complete press Save Changes to save mask database file.

Starting SRS data preparation

Next step is to complete the SRS data for validation. Press *Prepare SRS Data*.

| EPFD Data Preparation | | | | | | | |
|--|--|--|--|--|--|--|--|
| In this dialog you can either select the databases containing the data for EPFD examination or prepare the Appendix 4 data elements required for EPFD examination of the filing or create and/or validate new databases | | | | | | | |
| Please select the databases required for examination Select the databases for examination | | | | | | | |
| Select the database with the masks | | | | | | | |
| | | | | | | | |
| Select SRS database with non-gso filing for examination | | | | | | | |
| Return to GIBC | | | | | | | |
| Prepare the Appendix 4 data elements required for EPFD examination | | | | | | | |
| 1. Create Masks Database | | | | | | | |
| PFD/EIRP Mask Operations | | | | | | | |
| | | | | | | | |
| 2. Create SRS Database | | | | | | | |
| Prepare SRS Data | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| Close | | | | | | | |

Figure 21: Advancing to SRS data manipulation

| Prepare SRS Data Wizard | – 🗆 X | | | | | | |
|---|--------------|--|--|--|--|--|--|
| Welcome Input SRS Data Import Select NoticeID Linking to PFD/EIRP masks Validation Finish | | | | | | | |
| Use this wizard to create examination database with the notice of non-GSO filing prepared for EPFD examination. | | | | | | | |
| It is assumed that the filing is already captured using SpaceCap or is contained in an existing database (SRS_ALL.MDB). | | | | | | | |
| The purpose of this wizard: | | | | | | | |
| 1. To validate the data required for an examination. | | | | | | | |
| 2. To establish correct links to the masks contained in a mask database. | | | | | | | |
| 3. To finalize MDB file to be used in the examination. | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| Cancel Prev Next | Support | | | | | | |

Figure 22: Prepare SRS data start screen

A dialog in form of step-by-step wizard is opened. To advance to the next step press **Next**.

| Prepare SRS Data Wizard | _ □ X | | | | | | |
|--|----------------|--|--|--|--|--|--|
| Welcome hput SRS Data hoot Select NoticeID Linking to PFD/EIRP masks Validation Finish | | | | | | | |
| Select a working database | | | | | | | |
| First step is to create a new database or open an existing database to work with. | | | | | | | |
| If you choose to create a new database you can import at the next step notice of interest from a SpaceCap produce database or SRS_4 database. | ALL | | | | | | |
| If you are running Prepare Wizard for the first time, it is recommended to start working with a new database and to import the filing from another database. When a new database is created all very large earth stations would be contained already in this database which would facilitate No. 9.7 examination. | ю | | | | | | |
| Alternatively, you can open an existing examination database to continue validation or to import an additional filing from SRS_ALL dtaba or SpaceCap produced database. | ase | | | | | | |
| New examination database | | | | | | | |
| Open existing examination database | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| Cancel Prev Next | <u>Support</u> | | | | | | |

Figure 23: Creating new SRS data database

Similarly, we start from creating a new database. *Open existing examination database* could be selected alternatively to continue the working with already created database.

| ï | | | | | Pre | epare | SRS Data Wizard | - 🗆 X |
|---|----------------|--------|-----------------|---------------------------|-----------------------------|--------------------|---|---------|
| Welcome | Input SRS Data | Import | Select NoticeID | Linking to PFD/EIRP masks | Validation F | Finish | | |
| | | | | | | | | |
| Import the filing from another database | | | | | | | | |
| | | | | | | | | |
| | | | | You can import a non- | Press the b GSO filing f | outton b from a | below to launch the Import Wizard. n existing SpaceCap database or SRS_ALL database. | |
| | | | | | lf | no imp | port is need, press Next. | |
| | | | | | | | | |
| | | | | | | Im | port from an existing database | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| Cana | | | Press | Neut | | | | |
| Canc | ei | | Prev | Ivext | | | | Support |

Figure 24: Importing filing to SRS database used for EPFD validation

After a new database is created, we can import existing filing from another database (for example, SRS_ALL).

Press Import from an existing database.

Importing filing from another database

| V Import Wizard | - 0 | × |
|-----------------------------------|---|--------|
| Select source database and notice | | |
| Press to select input database | Data base location | |
| Select source database | | |
| Enter notice ID | Press to open the notice | |
| | Open Notice | |
| Frequency Assignments | | |
| Choose what to import from Notice | Selected function let you choose which groups will be imported from an existing hotice. | |
| Generate From Masks | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| Satellite Name | , | |
| | | |
| Cancel | Prev Next S | upport |

Figure 25: Selecting source database

On this page, the source database and corresponding Notice ID for the notice which is to be imported to a new database need to be indicated.

'Frequency Assignments' box gives 3 options for importing frequency assignments groups.

- 1. Choose what to import from Notice
- 2. Generate from Masks
- 3. Generate from Notice

First option is a default method of selecting frequency assignments groups which can be imported from source databased. Under this option, program looks for frequency assignments groups which are subject to Article 22 or No. 9.7B coordination provision and lets user to select which are the groups need to be imported from.

Second option is using information provided in the masks regarding minimum and maximum frequency of the frequency range to which particular PFD/EIRP mask is applicable. Provided that only single PFD or EIRP mask is applicable to specific frequency range only one new group will be generated.

The advantage of this option is that user don't have to decide which exact frequency groups needs to be imported – program will generate new groups for the user.
Third option, like in the case of the first uses information on Article 22 EPFD limit applicable frequency band and frequency assignments used in the mask. But unlike first option, this option generates completely new groups, while avoiding having multiple groups operating in overlapping frequency band.

This can be illustrated as follows:

- Notice has frequency assignment groups:

Group ID No. 1 – frequency band 10950-11200 MHz

Group ID No. 2 – frequency band 11200-11450 MHz

Group ID No. 3 – frequency band 11200-11400 MHz

- These frequency assignments groups are subject to the same EPFD limits in Article 22 applicable to the frequency bands:

10.7-11.7 GHz 11.2-12.2 GHz 12.2-12.5 GHz

- 12.5-12.75 GHz
- Under option 1, user must select carefully 3 different groups. However, under option 3 program would automatically create one group with combined frequency range 10.95-11.4 GHz.

Like in case of the option 2, the advantage of this option is that user don't have to decide which exact frequency groups needs to be imported – program will generate new groups for the user.

Example of using this interface is given below.

| 🖉 Import Wizard | - c |) X |
|---|--|---------|
| Select source database and notice | | |
| Press to select input database Select source database | Data base location C:\EPFDDemo\NSKY\NSKY-CRC.mdb | |
| Enter notice ID 104 | Press to open the notice Open Notice | |
| Frequency Assignments Choose what to import from Notice Generate From Masks Generate from Notice | Selected function let you choose which groups will be imported from an existing notice | |
| Satellite Nam | ə NSKY | |
| Cancel | Prev Next | Support |

Figure 26: Selecting notice to import

Select a source database and input the Notice ID in the text box and press **Open Notice**.

Here we start with the Option 'Choose what to import from Notice'.

If notice is found by its Notice ID number, satellite name would appear below, and you may continue to the next step.

Next step is to select orbital planes for import.

V Import Wizard

- 🗆 X

Check orbital planes to import

| Include | ntc_id | orb_id | nbr_sat_pl | right_asc | inclin_ang | prd_ddd | prd_hh | prd_mm | apog | а |
|--------------|--------|--------|------------|-----------|------------|---------|--------|--------|------|---|
| \checkmark | 104 | 1 | 10 | 0 | 53 | 0 | 1 | 48 | 800 | 0 |
| \checkmark | 104 | 3 | 10 | 90 | 53 | 0 | 1 | 48 | 800 | 0 |
| \checkmark | 104 | 4 | 10 | 135 | 53 | 0 | 1 | 48 | 800 | 0 |
| \checkmark | 104 | 5 | 10 | 180 | 53 | 0 | 1 | 48 | 800 | 0 |
| \checkmark | 104 | 6 | 10 | 225 | 53 | 0 | 1 | 48 | 800 | 0 |
| \checkmark | 104 | 7 | 10 | 270 | 53 | 0 | 1 | 48 | 800 | 0 |
| \checkmark | 104 | 8 | 10 | 315 | 53 | 0 | 1 | 48 | 800 | 0 |
| ~ | 104 | 9 | 15 | 0 | 70 | 0 | 1 | 52 | 1000 | 0 |
| \checkmark | 104 | 10 | 15 | 60 | 70 | 0 | 1 | 52 | 1000 | 0 |
| \checkmark | 104 | 11 | 15 | 120 | 70 | 0 | 1 | 52 | 1000 | 0 |
| \checkmark | 104 | 12 | 15 | 180 | 70 | 0 | 1 | 52 | 1000 | 0 |
| \checkmark | 104 | 13 | 15 | 240 | 70 | 0 | 1 | 52 | 1000 | 0 |
| \checkmark | 104 | 14 | 15 | 300 | 70 | 0 | 1 | 52 | 1000 | 0 |
| \checkmark | 104 | 15 | 15 | 0 | 81 | 0 | 1 | 51 | 900 | 0 |
| \checkmark | 104 | 16 | 15 | 72 | 81 | 0 | 1 | 51 | 900 | 0 |
| \checkmark | 104 | 17 | 15 | 144 | 81 | 0 | 1 | 51 | 900 | 0 |
| \checkmark | 104 | 18 | 15 | 216 | 81 | 0 | 1 | 51 | 900 | 0 |
| \checkmark | 104 | 19 | 15 | 288 | 81 | 0 | 1 | 51 | 900 | 0 |
| | 104 | 2 | 10 | 45 | 53 | 0 | 1 | 48 | 800 | 0 |

Figure 27: Selecting orbital planes to import

On this page user need to check all the orbital planes which will be used in EPFD Examination. Select orbital planes by checking 'Include' field in the table.

Next step is to select frequency groups to import.

This dialog is provided for the first option of importing groups.

On the left the list of applicable EPFD limits band is extracted. When clicking any of those limits the user is presented with the list of the groups which are subject to the limit selected. In the group list to import the group check **Import** in the left-most column.

| f mask link information is present in th | ne source database corre | sponding groups | will be preselected a | automatically | | | |
|--|--------------------------|-----------------|-----------------------|---------------|-------|-------|----|
| Select applicable EPFD limits band | Check groups to exam | ine | | | | | _ |
| 17300-17800 (Earth-space) 17300-18100 (Earth-space) | Import | grp_id | beam_name | emi_rcp | 17950 | 10200 | + |
| 17800-18400 (space-Earth) 17800-18600 (space-Earth) | | 104038 | | | 17950 | 10200 | - |
| 19700-20200 (space-Earth) 27500-28600 (Earth-space) | | 104055 | DPLH | E | 17950 | 18200 | - |
| 2/300-20000 (Lattinspace) | | 104101 | DPLH | F | 17950 | 18200 | - |
| | | 104102 | DPLH | F | 17950 | 18200 | - |
| | | 104102 | DPLH | F | 17950 | 18200 | - |
| | | 104104 | DPLH | E | 17950 | 18200 | - |
| | | 104105 | DPLH | E | 17700 | 17950 | - |
| | | 104106 | DPLH | E | 17700 | 17950 | - |
| | | 104107 | DPLH | E | 17700 | 17950 | - |
| | | 104108 | DPLH | E | 17700 | 17950 | - |
| | | 104109 | DPLH | E | 17700 | 17950 | - |
| | | 104110 | DPLH | E | 17700 | 17950 | - |
| | | 104111 | DPLH | E | 17700 | 17950 | - |
| | | 104112 | DPLH | E | 17700 | 17950 | |
| | | 104113 | DPLH | E | 17700 | 17950 | ٦ |
| | | 104114 | DPLH | E | 17700 | 17950 | |
| | < | | ill | | | > | ۰Ī |

Figure 28: Selecting groups to import

Next step is to select corresponding associated earth station for each frequency assignment group selected at the previous step. This is needed since groups may contain several associated earth stations. Program preselects first station in the list in each group.

The choice of the earth station does not affect the results of EPFD Examination, except the case when group contain both two different types of earth stations – typical and specific.

Typical earth station (stn_type=T) is an earth station which does not have specific geographical coordinates.

Specific earth station (stn_type=S) is an earth station which is located at given geographical coordinates.

In case group has both types, user need to carefully select type of earth station to be imported. Please note, that only 1 type of earth station maybe used in calculation at the same time.

| | | | Import V | Vizard | | | _ □ |
|---|--|-------------------|---------------------|------------------|----------|---------|------|
| Select earth stations to One earth station - typical o | o import or specific, if applicable | (by default, firs | st station is seled | cted for import) | | | |
| Select group | Check ea | rth station to ir | mport | | | | |
| 104043 | lr Ir | nport | seq_no | stn_name | stn_type | lat_dec | gain |
| 104098 | ▶ | ✓ | 1 | ES-E | т | | 41 |
| | < | | | 11 | | | |
| - | | | | | | | |
| Cancel | Prev | Next | | | | | Supp |

Figure 29: Selecting associated earth stations to import

For each of the selected groups, which are present in a left-side box, it is necessary to choose associated earth station to import.

Finally, the wizard provides a summary of elements to import. Press *Finish* to close the wizard.

| V | Import Wizard | _ | | x |
|---|---------------|---|-------|------------|
| Summary of elements for import | | | | 1 |
| Number of orbits to import | 19 | | | |
| Number of groups to import | 6 | | | |
| Number of assoc. earth stations to import | 6 | | | |
| Press 'Finish' to proceed with the in | mport | | | |
| Cancel Prev | / Finish | | Suppo | <u>ort</u> |

Figure 30: Import summary

Once Import Wizard finishes, the program will with SRS Data wizard.

In case user selected the import option 'Generate from Masks', process will be very similar.

Instead of selecting groups, on the screen below the program requests the user to indicate Mask Database file.

V Import Wizard \times Open Mask database file containing the masks which will be used as a source to generate new groups C:\EPFDDemo\NSKY\NSKY-Masks.mdb Open mask file Following groups will be generated Based on mask(s) 17800-18 Reference 19700-20200 (space-Earth) 17300-30000 (Earth-space) Low High Mask ID Bandwidth Туре Data Type _mask_orbit Frequency Frequency (kHz) 17800 18600 40 1 azimuth_ele.. Space statio ... 2 17800 18600 1000 Space statio.. azimuth_ele. 3 17800 18600 40 Space statio ... azimuth_ele.. 4 1000 17800 18600 Space statio ... azimuth_ele... 5 17800 18600 40 Space statio.. azimuth_ele.. 6 17800 18600 1000 Space statio ... azimuth_ele.. Prev Cancel Next Support

EPFD VALIDATION SOFTWARE USER GUIDE



Here user included mask database file. Program identified that 3 groups may be generated based on mask information.

Similar process is found in case of the import option 'Generate from Notice'.

| Section Section <t< th=""><th>-</th></t<> | - |
|---|------|
| Following groups will be generated Based on existing groups in notice 17300-17700 (Earth-space) grp_id beam_name emi_rcp freq_min freq_max elev_min 17800-17950 (space-Earth) 104043 U1 R 17300 17700 27500-28600 (Earth-space) 104044 U1 R 17300 17700 104045 U1 R 17300 17700 Integer (Construction of the second of the se | |
| 17300-17700 (Earth-space) grp_id beam_name emi_rcp freq_min freq_max elev_min 17800-17950 (space-Earth) 104043 U1 R 17300 17700 27500-28600 (Earth-space) 104044 U1 R 17300 17700 104045 U1 R 17300 17700 Integration | |
| 19700-20200 (space-Earth) 100000 010000 101000 101000 27500-28600 (Earth-space) 104044 U1 R 17300 17700 104045 U1 R 17300 17700 | |
| 104045 U1 R 17300 17700 | |
| | |
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| | |
| Cancel Prev Next | port |

Figure 32

In given example program identified that 4 groups may be generated using frequency assignment groups in the notice and Article 22 limits. These 4 groups ultimately substitute around 50 groups present in the notice.

Once import is completed, user is invited to continue operations with the newly imported notice.

| V | Prepare SRS Data Wizard | _ 🗆 X |
|---|--|---------|
| | Welcome Input SRS Data Import Select NoticeID Linking to PFD/EIRP masks Validation Finish | |
| | | |
| | | |
| | Select a notice ID | |
| | Select a notice ID from drop down box below. The corresponding filing will be used further for validation and mask link creation. | |
| | 104 NSKY V | |
| | | |
| | | |
| | | |
| | | |
| | Cancel Prev Next | Support |

Figure 33: Selecting notice ID

On this page, the Notice ID of the notice is selected.

| | Establishi | ng mask links | | |
|---|---|---|-------------------------------|---------|
| V Prepare SRS Data Wizard | | | - [|) X |
| Welcome Input SRS Data Import Select NoticeID | Linking to PFD/EIRP masks Validation Finish | | | |
| Open mask file | | | | |
| Select the group | Assign applicable mask(s) | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| Applicable limits info | | | | |
| | | | | |
| | | | | |
| | | | | |
| | - | | | |
| | Assign orbits to selected mask | Assign associated earth station selected mask | Save link data in the databas | е |
| | | | | |
| Cancel | Prev Next | | | Support |

Figure 34: Mask linking starting dialog

One of the main features of *EPFDPrepare* is helping to create the mask link tables in SRS database that are needed to link each mask to specific examination frequency assignment group.

Process starts by clicking "Open mask file".

| V Prepare SRS Data Wizard | | | | | | | | — C |) × |
|---|-------------------|----------------|-------------------|-------------------|------------------------------|-------------------|---------------------|-------------------|---------|
| Welcome Input SRS Data Import Select NoticeID | Linking to PFD/EI | RP masks | Validation Finish | | | | | | |
| Open mask file | C:\EPFDDemo\ | NSKY\NSKY | '-Masks.mdb | | | | | | |
| Select the group | Assign app | licable m | nask(s) | | | | | | |
| is ⊖-down | Assigne | ed Mask ID | Low Frequency | High Frequency | Reference Bandwidth (kHz) | Туре | Data Type | Orbital Planes | |
| | | 8 | 19700 | 20200 | 1000 | Space station PFD | azimuth_elevation | All | |
| | | 10 | 19700 | 20200 | 1000 | Space station PFD | azimuth_elevation | All | |
| | | 12 | 19700 | 20200 | 1000 | Space station PFD | azimuth_elevation | All | |
| Applicable limits info Property Value Article 22, TABLE 22-1C Direction down Low frequency 19700 High frequency 20200 Reference ba 40 | | | | | | | | | |
| Appendix 5, TABLE 5-1, RR9.7A | Assig | in orbits to s | selected mask | Assign as | sociated earth station sel | ected mask | Save link data in t | he database | à |
| Cancel | Prev | | Next | | | | | | Support |

Figure 35: Opening mask database

First, we need to open mask database containing all the masks in XML-format.

After the database is opened, the list of groups is generated which are overlapping with the masks present in the database.

The list is split into three categories – groups subject to EPFD on downlink (down), EPFD on uplink (up) and EPFD on inter-satellite link (is). Clicking any of these categories expands the list of associated groups that are subject to the corresponding limits.

When the user clicks group, the list of applicable masks is displayed in the table *Assign applicable mask(s)*.

Applicable limits info is provided in the box of the bottom of the page that displays the list of RR Article 22 and 9.7A/B applicable limits for the currently selected group.

Using this information, the user can check the overlap between group and applicable limit, determine the requirement for the reference bandwidth (40 kHz, 1000 kHz or both) and accordingly assign the mask to the group.

To assign specific mask the selected group, *Assigned* field in the table should be checked.

Moreover, it is possible to assign each mask to different orbits. For this, select the mask and press **Assign orbit** to selected mask.

In this example, we have three different masks, which we would like to assign to different sets of orbital planes 1-8, 9-14, 15-19.

Example below is given applying the mask to orbits 1-8.

| V s | elect Orbital I | Planes using this | mask | | | | | | | - | - 🗆 | × |
|-----|-----------------|----------------------------|----------------------------------|-------------------------------|-------------|-------------------------------------|---------------------------------|---------------------------------|-------------------------------|----------------------------|------------|-------|
| | | | | | | | | | | | | Help |
| | Flag 'AllSa | If you tellites' in the | want to assign table below wh | this mask to ich indicates | whether all | tellite(s) pleas satellites in o | e click 'Assi rbital plane a | gn the mask t re using the s | o specific sat ame mask wi | ellites'. Il be changed | l accordin | gly. |
| | Include | AllSatellites | orb_id 🔺 | nbr_sat_pl | right_asc | inclin_ang | prd_ddd | prd_hh | prd_mm | apog | apog | exp p |
| | \checkmark | All | 1 | 10 | 0 | 53 | 0 | 1 | 48 | 800 | 0 | 80 |
| | \checkmark | All | 2 | 10 | 45 | 53 | 0 | 1 | 48 | 800 | 0 | 80 |
| | \checkmark | All | 3 | 10 | 90 | 53 | 0 | 1 | 48 | 800 | 0 | 80 |
| | \checkmark | All | 4 | 10 | 135 | 53 | 0 | 1 | 48 | 800 | 0 | 80 |
| | \checkmark | All | 5 | 10 | 180 | 53 | 0 | 1 | 48 | 800 | 0 | 80 |
| | \checkmark | All | 6 | 10 | 225 | 53 | 0 | 1 | 48 | 800 | 0 | 80 |
| | \checkmark | All | 7 | 10 | 270 | 53 | 0 | 1 | 48 | 800 | 0 | 80 |
| ۲. | | All | 8 | 10 | 315 | 53 | 0 | 1 | 48 | 800 | 0 | 80 |
| | | All | 9 | 15 | 0 | 70 | 0 | 1 | 52 | 1000 | 0 | 10 |
| | | All | 10 | 15 | 60 | 70 | 0 | 1 | 52 | 1000 | 0 | 10 |
| | | All | 11 | 15 | 120 | 70 | 0 | 1 | 52 | 1000 | 0 | 10 |
| | | All | 12 | 15 | 180 | 70 | 0 | 1 | 52 | 1000 | 0 | 10 |
| | | All | 13 | 15 | 240 | 70 | 0 | 1 | 52 | 1000 | 0 | 10 |
| | | All | 14 | 15 | 300 | 70 | 0 | 1 | 52 | 1000 | 0 | 10 |
| | | All | 15 | 15 | 0 | 81 | 0 | 1 | 51 | 900 | 0 | 90 |
| | | All | 16 | 15 | 72 | 81 | 0 | 1 | 51 | 900 | 0 | 90 |
| | | All | 17 | 15 | 144 | 81 | 0 | 1 | 51 | 900 | 0 | 90 |
| | | All | 18 | 15 | 216 | 81 | 0 | 1 | 51 | 900 | 0 | 90 |
| | | All | 19 | 15 | 288 | 81 | 0 | 1 | 51 | 900 | 0 | 90 |
| | | | | | | | | | | | | |
| < | | | | | | | _ | | | _ | _ | > |
| | | | | | | | | | | | | |
| A | ssign the mask | to specific satel | lites | | | | Sa | ave | | Clo | se | |

Figure 36: Assigning orbits to specific mask

Under certain circumstances user may require applying different masks to different satellites.

This can be done by clicking 'Assign the mask to specific satellites.

| V A | ssign mask to | specific sate | ellites | | | | _ | | × |
|------------|-----------------------------------|---------------------------|----------|---------|---------------------------------|-----------------------|-----|-----|---|
| | | | | | Check satellites using this mas | k | | | |
| Selec | ct Orbit ID to | edit | 1 | | ← ← → → | Total orbital planes: | 19 | | |
| | Assigned | Mask ID | Orbit ID | Sat ID | | | | | |
| | | 10 | 1 | 1 | | | | | |
| | | 10 | 1 | 2 | | | | | |
| | | 10 | 1 | 3 | - | | | | |
| 1 | | 10 | 1 | 4 | | | | | |
| | | 10 | 1 | 5 | - | | | | |
| | | 10 | 1 | 6 | - | | | | |
| | | 10 | 1 | / | - | | | | |
| | | 10 | 1 | 9 | | | | | |
| | | 10 | 1 | 10 | | | | | |
| | | 10 | | 10 | | | | | |
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| | | | | | | | | | |
| | Check Al | l | Unch | eck All | | | | | |
| Co | py mask per se signment to oth | atellite(s) ner orbits | | | | Save | Cle | ose | |

Figure 37. Assigning the mask to satellites

After selection of satellites is done, click 'Save'.

Now window shows that only satellites 1 to 4 in orbital plane 1 will be using this mask.

| Include | AllSatellites | orb_id | ▲ nbr_sat_pl | right_asc | inclin_ang | prd_ddd | prd_hh | prd_mm | apog | apog_ex |
|--------------|---------------|--------|--------------|-----------|------------|---------|--------|--------|------|---------|
| \checkmark | 1,2,3,4 | 1 | 10 | 0 | 53 | 0 | 1 | 48 | 800 | 0 |
| | | 2 | 10 | 45 | 53 | 0 | 1 | 48 | 800 | 0 |
| | | 3 | 10 | 90 | 53 | 0 | 1 | 48 | 800 | 0 |
| | | 4 | 10 | 135 | 53 | 0 | 1 | 48 | 800 | 0 |
| | | 5 | 10 | 180 | 53 | 0 | 1 | 48 | 800 | 0 |
| | | 6 | 10 | 225 | 53 | 0 | 1 | 48 | 800 | 0 |
| | | 7 | 10 | 270 | 53 | 0 | 1 | 48 | 800 | 0 |
| | | 8 | 10 | 315 | 53 | 0 | 1 | 48 | 800 | 0 |
| | | 9 | 15 | 0 | 70 | 0 | 1 | 52 | 1000 | 0 |
| | | 10 | 15 | 60 | 70 | 0 | 1 | 52 | 1000 | 0 |
| | | 11 | 15 | 120 | 70 | 0 | 1 | 52 | 1000 | 0 |
| | | 12 | 15 | 180 | 70 | 0 | 1 | 52 | 1000 | 0 |
| | | 13 | 15 | 240 | 70 | 0 | 1 | 52 | 1000 | 0 |
| | | 14 | 15 | 300 | 70 | 0 | 1 | 52 | 1000 | 0 |
| | | 15 | 15 | 0 | 81 | 0 | 1 | 51 | 900 | 0 |
| | | 16 | 15 | 72 | 81 | 0 | 1 | 51 | 900 | 0 |
| | | 17 | 15 | 144 | 81 | 0 | 1 | 51 | 900 | 0 |
| | | 18 | 15 | 216 | 81 | 0 | 1 | 51 | 900 | 0 |
| | | 19 | 15 | 288 | 81 | 0 | 1 | 51 | 900 | 0 |



Please note, that normally it may be enough to apply single mask to all orbital planes.

Possibility to assign masks to different satellites and orbits is given to address complex scenarios.

This step is repeated in case there are different applicable reference bandwidths of the limit and we have different masks for each of the reference bandwidth.

As it was already mentioned it is not necessary to assign the same masks to different groups, it is enough to define scenario for single group covering specific applicable limit. If there are several groups operating in the same frequency band using the same mask, the software will select only one group for validation.

| Welcome Input SRS Data Import Select Notic | eID Linking t | o PFD/EIRP | masks V | alidation Finish | | | | | | |
|---|---------------|--------------|--------------|------------------|-------------------|------------------------------|--------------------|--------------|-------------------|------------------------|
| Open mask file | C:\EPF | DDemo\NS | KY\NSKY- | Masks.mdb | | | | | | |
| Select the group | Assi | gn applic | able ma | ask(s) | | | | | | |
| is ⊟-down | | Assigned | Mask ID | Low Frequency | High Frequency | Reference Bandwidth (kHz) | Туре | Data Type | Orbital Planes | Associate Earth Sta |
| | A | \checkmark | 13 | 17300 | 30000 | | Earth station EIRP | off-axis | All | |
| up | | | 14 | 17300 | 30000 | | Earth station EIRP | off-axis | All | |
| | | | 15 | 17300 | 30000 | | Earth station EIRP | off-axis | All | |
| 104055 (27500-28600) | | | 16 | 17300 | 30000 | | Earth station EIRP | off-axis | All | |
| Applicable limits into Property Value Article 22, TABLE 22-1C Direction up Low frequency 17300 High frequency 17800 | ^ | | | | | | | | | |
| Reference ba 40 | < | | | | | | | | | > |
| Appendix 5, TABLE 5-1, RR9.7A Direction up | ~ | Assign | orbits to se | elected mask | Assign asso | ciated earth station select | ted mask | Save link | data in the datab | ase |
| | | | | | | | | | | |

Figure 39: Assigning EIRP masks to specific group

For the uplink, we need to assign earth station EIRP mask.

The procedure is like the previous case, but in addition, of assigning orbits it is possible to assign also type of earth station – whether it is typical or specific (having exact location).

To assign specific mask to the associated earth station, select the mask and press **Assign associated earth station** *for selected mask*.

In the dialog below user can select earth station to be considered for selected group and mask. Choosing different typical earth stations would not change the results since transmission characteristics of the earth station are represented by EIRP mask under consideration. However, if there are different types of earth stations – typical or specific, changing from typical to specific will affect the results. For specific earth station the worst-case geometry algorithm takes the coordinates of specific earth station as worst-case coordinates.

| 灯 Choose Associated Ear 🗕 🗖 🗙 |
|--|
| Select earth station from dropdown list for the given group and mask combination |
| |
| No.: 1 Name: ES-E Type: T No.: -1 Name: ANY Type: T mask is applicable for Typical ES, any typical ES could be selected |
| Save Cancel |

Figure 40: Assigning mask to associated earth station

In addition, in this dialog the user can select earth station No. -1 which signifies that any typical earth station is considered as associated to selected mask.

After the mask link data is established save it by pressing *Save link data in the database*.

You may continue to the next step of data validation.

| Validating the filing | |
|---|----------|
| Prepare SRS Data Wizard | _ 🗆 X |
| Wetcome Input SRS Data Import Select NoticeID Linking to PFD/EIRP masks Validation Finish Start Masks Groups Non-geo Method Non-geo Density Sat Oper Orbit Finish Press 'Continue' to start step-by-step validation process. After the element is validated you can press 'Continue' to continue with the validation of the next element. | Continue |
| Cancel Prev Next | Support |

Figure 41: Validation process start screen

Next step is to continue with validation of the filing.

| Prepare SRS Data Wizard | _ 🗆 🗙 |
|-------------------------|----------|
| | Continue |
| Cancel Prev Next | Support |

Figure 42: Validating mask link information

The wizard starts with checking of PFD/EIRP mask linking information.

This check includes verification of the data elements in the tables **mask_info**, **mask_lnk1**, **mask_lnk2**. Also, it checks whether all the applicable limits are covered by combination of masks linked to the group.

Possible error messages:

- Mask_info table has missing values in some of the fields
- Mask_info table has no mask type defined or wrong mask type
- Mask_lnk1/Mask_lnk2 table has missing grp_id.
- Mask_lnk1/Mask_lnk2 table contains record(s) with grp_id=X for which no record is present in grp table.
- Mask_lnk1/Mask_lnk2 table has missing mask_id.
- Mask_Ink1/Mask_Ink2 table contains record(s) with Mask_id=X for which no record is present in mask info.
- Mask_Ink1/Mask_Ink2 table contains record(s) with for grp_id=X referring to mask_id=Y having nonoverlapping applicable frequency range in mask_info table.
- Mask_lnk1/Mask_lnk2 table contains record(s) with orb_id=X which are not present in the filing.
- Direction: down/up/is, Limit: X, Low freq: Y, High Freq: Z is not covered by mask_lnk tables for all the orbits in the filing

| V | | | | | Prepare SRS | Data Wizard | | – – X |
|----------|---|--|--|---|--|-------------------------------|------------------|--------------|
| W | elcome Input SRS Data Start Masks Groups | Import Select Notice Non-geo Method Non | ID Linking to PFC |)/EIRP masks Val Oper Orbit Fini | idation Finish | | | |
| | | | | Frequenc | cy groups v | validation | | |
| | | Err | or Found. Mir | nimum elevati | on angle is mis | sing for one or s | several records. | |
| | | Plea Plea with t | se correct the d se enter minimu two decimal po: | ata ım elevation anç sitions for each ç | gle (A.14.b.4) of the group and press U | earth station expre pdate | essed in degrees | |
| | | | GroupID | Beam Name | Emission Direction | Minimum Elevation Angle | ^ | |
| | | | 104043 | U1 | R | 30 | | |
| | | | 104098 | DPLH | E | 30 | = | |
| | | | 104105 | DPLH | E | 30 | | |
| | | 1 | 104119 | DPLH | E | 30 | | |
| | | | 104001 | DFLH | E | | | |
| | | | 104055 | U2 | R | | ~ | |
| | | | | | Update | | | |
| | Cancel | Prev | Nex | đ | | | | Support |

Figure 43: Validation frequency groups

This check includes verification of the data elements in the **grp** table. It checks whether the element A.14.b.4 (elev_min) is given for all the groups subject to examination.

If it is not present, the user can enter it for each group in the same table. After entering missing data, press *Update*.

| V | Prepare SRS Data Wizard | _ 🗆 X |
|--|--|---------|
| Welcome Input SRS Data Import Select NoticeID Linking to PFD/E Start Masks Groups Non-geo Method Non-geo Density Sat Opr Exclusion Zor Exclusion Zor Density Sat Opr | IRP masks Validation Finish eer Orbit Finish ne method (A.4.b.7.d.1 and A.4.b.7.d.2) | |
| Error Found. No exclus | sion angle is provided. Please provide exclusion angle below. | |
| Pie | Exclusion zone method Exclusion zone angle Update | |
| Cancel Prev Next | | Support |

Figure 44: Validating exclusion zone method

This check includes verification of the data elements in the **non_geo** table. It checks exclusion zone method data elements.

If some data is missing or wrongly defined, the user can enter it. After entering missing data, press **Update**.

| V Prepare SRS Data Wizard - | | \times |
|--|---------|----------|
| Welcome Input SRS Data Import Select NoticeID Linking to PFD/EIRP masks Validation Finish | | |
| Population of earth stations (A.4.b.7.b and A.4.b.7.c) | | |
| These are required for uplink EPFD analysis: density - Average number of associated earth stations transmitting with overlapping frequencies per km² in a cell avg_dist - Average distance between co-frequency cells in kilometres NUM_ES = ES_DISTANCE * ES_DISTANCE * ES_DENSITY | | |
| Special case: • Locate single non-GSO earth station at the boresight of GSO: density=1 and avg_dist = 0 km The number of earth stations transmitting at the same time on the same frequency seems to high. In example area of the circle with R=1000km the number is 3141592,65358979. You may wish to review the figure. | Contine | ue |
| Please correct the data Average distance (km) 60 Density (1/km²) 1 Update | | |
| Cancel Prev Next | | |

Figure 45: Validating earth station distribution

This check includes verification of the data elements in the **non_geo** table relating to earth station distribution parameters.

If calculated value of earth stations within an example circle is very high (more than 1000) it would give an error - the number of earth stations, transmitting at the same time on the same frequency seems to be high.

If some elements are missing or data looks unrealistic, the user can change it on the same page. After the entering missing data, press **Update**.

| V | | | Prepare S | RS Data Wizard | | | - 🗆 X |
|--|---|---|---|--|---|---------------------------|----------------|
| Welcome Input SRS Data Import Select Start Masks Groups Non-geo Method | NoticeID Linking to | PFD/EIRP masks V Sat Oper Orbit Fi | alidation Finish | | | | |
| | Or | erational | latitude ra | anges (A.4. | b.6) | | |
| lat_fr, lat_to - lower upper nbr_op_sat - maximum n latitude range Entries should cover the w Fatal Error. No record is | r limit of the latitu umber of non-ge hole range from present in sat_c | ude range costationary sa -90 to 90 latitu oper table for th | tellites transmi de. ne selected No | tting with overlapp tice ID. Please, re | oing frequencies to a un SpaceCap to see | given location within the | |
| | Please correct the | data | | | | | |
| | ntc_id | lat_fr | lat_to | nbr_op_sat | change_ts | | |
| | • | | | | Update | | |
| Cancel | Prev | Next | | | | | <u>Support</u> |

Figure 46: Validating operational latitude ranges

This check includes verification of the data elements in the **sat_oper** table relating to operational latitude range of the system.

Some filings in SRS do not have this data captured. When the filing is imported from SRS, this table stays empty and it is necessary to provide the data for the whole range -90 to 90 latitude.

| V | | | | Prepare S | SRS Data Wizard | | | - 🗆 X |
|--|--|---|---|------------------------------------|--|--|---|---------|
| Welcome Input SRS Data Import Sele Start Masks Groups Non-geo Meth | ct Noticel | D Linking to PFD |)/EIRP masks Valid Oper Orbit Finisl | ation Finish | | | | |
| | | Оре | rational la | atitude ra | anges (A.4. | b.6) | | |
| lat_fr, lat_to - lower upper nbr_op_sat - maximum latitude range Entries should cover the Fatal Error. No record is | er limit (number whole ra preser | of the latitude r of non-geos ange from -9 nt in sat_ope | e range stationary satel 0 to 90 latitude er table for the | lites transmi e. selected No | tting with overlapp btice ID. Please, r | bing frequencies to un SpaceCap to se | a given location within the ee the data is complete. | |
| | | ntc_id | lat_fr | lat_to | nbr_op_sat | change_ts | | |
| | | 104 | -90 | -45 | 2 | | | |
| | | 104 | -45 | 0 | 4 | | | |
| | | 104 | 0 | 45 | 4 | | | |
| | • | 104 | 45 | 90 | 2 | | | |
| | * | | | | | | | |
| | | | | | | | | |
| | Hev | INEX | u | | | | | Support |

Figure 47: Entering operational latitude ranges

If data is missing, the user can enter it on the same page.

Start entering data from -90 and finish with 90-degree latitude. In the given example, we are populating the table with different ranges, such as -90 to -45, -45 to 0, 0 to 45, 45 to 90.

After the entering missing data, press Update.

Possible error messages:

- White spaces found in latitude range -90 to 90. Table should cover whole latitude range.
- lat_fr should be less than Lat_to.
- Overlapping latitude ranges found. Latitude ranges should not overlap.
- No number of satellites are given for one or several records.
- No record is present in sat_oper table for the selected Notice ID. Please, run SpaceCap to see the data is complete.

| Prepare SRS Data Wizard | _ 🗆 X |
|---|---------|
| Welcome Input SRS Data Import Select NoticeID Linking to PFD/EIRP masks Validation Finish Statt Masks Groups Non-geo Method Non-geo Density Sat Oper Orbit Orbit parameters Orbit and Phase tables are Ok. Press 'Continue' | |
| Cancel Prev Next | Support |

Figure 48: Validating orbit parameters

This check includes verification of the data elements in the **orbit** and **phase** tables.

If some elements are missing or wrongly captured it would suggest running SpaceCap to correct the data.

Possible error messages:

- f_stn_keep (station keeping flag, A.4.b.6.c) is not given or not equal to Y or N
- op_ht or op_ht_exp (minimum transmitting altitude, A.4.b.4.f) is not given or not equal to Y or N
- Station keeping (A.4.b.6.c) is used but station keeping period value is not fully defined.
- f_precess (precession flag, A.4.b.6.e) is not given or not equal to Y or N
- Precession is used (A.4.b.6.e) but precession value is not defined.
- Phase table does not contain phase angles for all the satellites in the plane.

| Prepare SRS Data Wizard | _ 🗆 X |
|--|---------|
| Velcome Input SRS Data Import Select NoticeID Linking to PED/EIRP masks Veldation Finish Start Masks Groups Non-geo Method Non-geo Densty Sat Oper Otht Finish Validation is finished. Press 'Next' to advancte to the next step. Validation is finished. Press 'Next' to advancte to the next step. | |
| Cancel Prev Next | Support |

Figure 49: Finishing validation

| Prepare SRS Data Wizard | _ |
|---|-----------|
| Welcome Input SRS Data Import Select NoticeID Linking to PFD/EIRP masks Validation Finish | |
| | |
| | |
| | |
| | |
| | |
| | |
| Press 'Save' to finalize preparing input data | |
| | |
| Save Close | |
| | |
| | |
| | |
| | |
| | |
| Cancel Prev | Support |

Figure 50: Saving SRS-database

After the validation is finished press *Save* to save the final database. Resulting database can be provided as an input to validation tools on the main screen of *EPFDPrepare*.

Running EPFDPrepare as a stand-alone tool

When *EPFDPrepare* is launched from Start Menu (not from GIBC interface), the starting screen will be different.

| EPFD Data Preparation | _ | | × |
|---|---------|------------|-------|
| Prepare the Appendix 4 data elements required for Ef | PFD exa | aminatio | n |
| 1. Create Masks Database | | | |
| PFD/EIRP Mask Operations | | | |
| 2. Create SRS Database | | | |
| Prepare SRS Data | | | |
| | | | |
| Additional functions could be found here. These are use | d most | ly interna | ally. |
| Import LES to DB | | | |
| Merge DB | | | |
| Rename ntc_id | | | |
| Go to launcher | | | |

Figure 51: EPFDPrepare start screen

Three additional functions are appearing –*Rename ntc_id*, *Merge DB* and *Rename ntc_id*.

These are functions are used mostly internally in BR.

You can also start stand-alone EPFD validation launcher by clicking *Go to launcher*.

Stand-alone launcher is an alternative to GIBC interface.

It gives more control in terms of output database locations, possibility to review log-files, hardware options (number of CPU threads to use).

| V EPFD Data Prepara | ation | _ | | × |
|-------------------------|---|--------|----------------|--------|
| Enter notice ID nad Exa | mination | | | |
| Enter notice ID | Examination | п Туре | Article 22 | \sim |
| Select the database wit | h masks for examination | | | |
| Select SRS database w | ith non-gso filing for | | | |
| | | | | |
| Select Limits DB | | | | |
| | | | | |
| Select results database | e and view results | | | |
| Select results DB | | | | |
| | | | | |
| Generate new resu | lt database | | View re | sults |
| Options | | | | |
| Select Limits | Number of CPU cores to us | e 8 | | |
| Use Dual Time Step | Maximum cores available: | 8 | | |
| Use TS1 | Full WCG Down Check | | | |
| Start | | | | |
| Start with EPFD-T | | S | tart with EPFI | D-A |
| Path to EPFD-A | c:\Program Files (x86)\Agenium\EPFDvalidation\EPFDvalidation.exe | | EPFD-T Log | |
| Path to EPFD-T | c:\Program Files (x86)\S1503_2Analysis\Program\S1503_2.exe | | | |

Figure 52: Stand-alone launcher

ANNEX 1. EPFD RUN DEFINITION / RESULTS DATABASE

This section contains the definition of the runs as well as the results returned by the two software tools.

The GIBC (Graphical Interface for Batch Calculation) software uses the *epfd_results.MDB* database and stores in table *run_def* the parameters specifying the run options including the identifier (ntc_id) of the notice to be examined, either the ntc_id of the non-geostationary system or the ntc_id of the large earth station.

| run_def TABLE | | | | INPUT table |
|----------------------|-----------|--------------|---|------------------------|
| Data item | Data Type | Field Size | Description | Validation |
| run_def_id | Number | Long Integer | Unique identifier of the run definition | Primary key [Identity] |
| run_date_time | Date/Time | | Date/Time stamp when the run is requested | |
| ntc_id | Number | Long Integer | Unique identifier of the SRS notice to be examined | Foreign key (SRS) |
| run_type | Text | 3 | Art22 [A22], Art97A [97A], Art97B [97B] | |
| sw_name | Text | 1 | Software selected, Agenium [A] or Transfinite [T], to perform the examination | |
| srs_location | Text | 255 | Location of the SRS database file (MDB) | |
| masks_location | Text | 255 | Location of the PFD and EIRP MASKS database file (MDB) | |
| epfd_limits_location | Text | 255 | Location of the EPFD LIMITS reference database file (MDB) | |
| epfd_runs_location | Text | 255 | Location of the EPFD RUNS database file (MDB) | |

| result_def TABLE | | | | OUTPUT table |
|---------------------|-----------|--------------|---|-------------------|
| Data item | Data Type | Format | Description | Validation |
| run_def_id | Number | Long Integer | Unique identifier of the run definition | Foreign key |
| sw_name | Text | 1 | Software used, Agenium [A] or Transfinite [T], to perform this run | |
| sw_version | Text | 10 | Version number of the software used | |
| ntc_id | Number | Long Integer | Unique identifier of the SRS notice examined | Foreign key (SRS) |
| class | Text | 1 | NON-GSO system [N] or Large Earth Station [L] | |
| name | Text | 30 | Name of the NON-GSO system or Large Earth Station examined | |
| status | Text | 1 | Pass [P], Fail [F], Error [E] | |
| feedback | Text | 255 | Error information | |
| completed_date_time | Date/Time | | Date/Time stamp when the run is completed | |

| results TABLE | | | | OUTPUT table |
|--------------------------|-----------|-----------------|---|--------------|
| Data item | Data Type | Format | Description | Validation |
| run_def_id | Number | Long Integer | Unique identifier of the run definition | Foreign key |
| result_id | Number | Long Integer | Unique ID of the result data (Identity) | |
| epfd_type | Text | 1 | Up [U], Down [D], IS [I] | |
| freq_used | Number | Double | Frequency in MHz | |
| ntc_id | Number | Long Integer | The unique id of the notice used along with run_def.ntc_id to define this run (9.7A/B only) | |
| dish_size | Number | Double | Dish size in metres | |
| service | Text | 1 | FSS [F] or BSS [B] | |
| beamwidth | Number | Double | Beamwidth in degrees | |
| gain_pattern | Text | 50 | Gain pattern used | |
| reference_bandwidth | Number | Double | Reference bandwidth in MHz | |
| course_timestep_use d | Number | Double | Course time step in seconds | |
| fine_timestep_used | Number | Double | Fine time step in seconds | |
| number_timesteps | Number | Double | Number of time steps | |
| worst_es_lat | Number | Double | Worst Earth Station location latitude (Degrees) | |
| worst_es_long | Number | Double | Worst Earth Station location latitude (Degrees) | |
| worst_gso_long | Number | Double | Worst GSO longitude (Degrees) | |
| pass | Yes/No | | Has this check passed? | |
| percentage_complete | Number | Double | How far this check has progressed? | |

| cdf TABLE | | | | OUTPUT table |
|------------------|-----------|-----------------|--|--------------|
| Data item | Data Type | Format | Description | Validation |
| result_id | Number | Long Integer | Unique ID of the result set | Foreign key |
| epfd | Number | Double | In dB(W/m ²)·reference bandwidth | |
| limit_percentage | Number | Double | The limit percentage value | |
| calc_percentage | Number | Double | The calculated percentage value | |
| sequence | Number | Long Integer | Sequence number | |

ANNEX 2. SRS DATABASE REQUIRED PARAMETERS

This section details the parameters that the EPFD software uses from the SRS database.

Format Description

| Value | Description |
|-------|---|
| Х | Used to describe alphanumeric data. |
| | e.g. X(9) specifies a 9 character field containing alphanumeric data |
| | XXX is equivalent to X(3). |
| 9 | Used to describe digits |
| · · · | Shows the position of a decimal point |
| S | Implies a sign (sign leading separate) |
| | e.g. S999.99 implies a numeric field with a range of values from -999.99 to +999.99 |
| | 99 implies a numeric field with a range of values from 0 to 99 |

notice

| Data Item | Data Type | Format | Description | Validation |
|-----------|-----------|--------|---|---|
| ntc_id | Number | 9(9) | Unique identifier of the notice | Primary Key |
| ntc_type | Text | Х | code indicating if the notice is of a geostationary satellite [G], non-geostationary satellite [N], specific earth station [S] or typical earth station [T] | value != NULL |
| d_rcv | Date/Time | 9(8) | date of receipt of the notice | |
| ntf_rsn | Text | Х | code indicating that the notice has been submitted under RR1488 [N], RR1060 [C], RR1107 [D], 9.1 [A], 9.6 [C], 9.7A [D], 9.17 [D], 11.2 [N], 11.12 [N], AP30/30A-Articles 2A, 4 & 5 [B], AP30B-Articles 6 & 7 [P], AP30B-Article 8 [N] or Res49 [U] | The software looks a value that is 'C' or 'N' |
| st_cur | Text | ХХ | current processing status of the notice | The software looks for a value that is '50' in the Article 9.7A check |

non_geo

| Data Item | Data Type | Format | Description | Validation |
|------------|-----------|---------|---|---|
| ntc_id | Number | 9(9) | Unique identifier of the notice | Primary Key |
| sat_name | Text | X(20) | Name of the satellite | |
| nbr_sat_td | Number | 9(4) | Maximum number of co-frequency tracked non-geostationary satellites receiving simultaneously | value != NULL && value > 0 |
| avg_dist | Number | 9(3).9 | Average distance between co- frequency cells in kilometres | value != NULL && value > 0 |
| density | Number | 9(6).99 | Average number of associated earth stations transmitting with overlapping frequencies per km2 in a cell | value != NULL && value > 0 |
| f_x_zone | Text | х | Flag indicating the type of zone: if the exclusion zone angle is the angle alpha [Y] or the angle X [N] | value != NULL && (value == 'Y' 'N') |
| x_zone | Number | 99.9 | Width of the exclusion zone in degrees | value != NULL && value > 0 |

orbit

| Data Item | Data Type | Format | Description | Validation |
|------------|-----------|---------|---|-----------------------------|
| ntc_id | Number | 9(9) | Unique identifier of the notice | Foreign Key |
| orb_id | Number | 99 | Sequence number of the orbital plane | Primary Key |
| nbr_sat_pl | Number | 99 | Number of satellites per non- geostationary orbital plane | value != NULL && value > 0 |
| right_asc | Number | 999.99 | Angular separation in degrees between the ascending node and the vernal equinox | value != NULL |
| inclin_ang | Number | 999.9 | Inclination angle of the satellite orbit with respect to the plane of the Equator | value != NULL |
| apog | Number | 9(5).99 | The farthest altitude of the non- geostationary satellite above the surface of the Earth or other reference body – expressed in kilometres Distances > 99999 km are expressed as a product of the values of the fields "apog" and "apog_exp" (see below) e.g.: 125 000 = 1.25 x 10 ⁵ | value != NULL && value > 0 |
| apog_exp | Number | 99 | Exponent part of the apogee expressed in power of 10 To indicate the exponent; give 0 for 10 ⁰ , 1 for 10 ¹ , 2 for 10 ² , etc. | value != NULL && value >= 0 |
| perig | Number | 9(5).99 | The nearest altitude of the non- geostationary satellite above the surface of the Earth or other reference body – expressed in kilometres Distances > 99 999 km are expressed as a product of the values of the fields "perigee" and "perig_exp" (see `below) e.g.: 125 000 = 1.25 x 10 ⁵ | value != NULL && value > 0 |
| perig_exp | Number | 99 | Exponent part of the perigee expressed in power of 10 To indicate the exponent; give 0 for 10 ⁰ , 1 for 10 ¹ , 2 for 10 ² , etc. | value != NULL && value >= 0 |
| perig_arg | Number | 999.9 | Angular separation (degrees) between the ascending node and the perigee of an elliptical orbit. If RR No. 9.11A applies | |

orbit (continued)

| Data Item | Data Type | Format | Description | Validation |
|------------|-----------|--------|--|---|
| op_ht | Number | 99.99 | Minimum operating height of the non- geostationary satellite above the surface of the Earth or other reference body – expressed in kilometres Distances > 99 km are expressed as a product of the values of the fields "op_ht" | value != NULL && value > 0 |
| | | | and "op_ht_exp" (see below) e.g.: 250 = 2.5 x 10 ² | |
| op_ht_exp | Number | 99 | Exponent part of the operating height expressed in power of 10 To indicate the exponent; give 0 for 10^0 , 1 for 10^1 2 for 10^2 etc. | value != NULL && value >= 0 |
| f_stn_keep | Text | X | Flag indicating if the space station uses [Y] or does not use [N] station-keeping to maintain a repeating ground track | value != NULL && (value == 'Y' 'N') |
| rpt_prd_dd | Number | 999 | Day part of constellation repeat period (s) | |
| rpt_prd_hh | Number | 99 | Hour part of constellation repeat period (s) | |
| rpt_prd_mm | Number | 99 | Minute part of constellation repeat period (s) | |
| rpt_prd_ss | Number | 99 | Second part of constellation repeat period (s) | |
| f_precess | Text | X | Flag indicating if the space station should [Y] or should not [N] be modelled with specific precession rate of the ascending node of the orbit instead of the J2 term | value != NULL && (value == 'Y' 'N') |
| precession | Number | 999.99 | For a space station that is to be modelled with specific precession rate of the ascending node of the orbit instead of the J2 term, the precession rate in degrees/day measured counter-clockwise in the equatorial plane | If f_precess == 'Y' then value != NULL && value >= 0 |
| long_asc | Number | 999.99 | Longitude of the ascending node for the j th orbital plane measured counter-clockwise in the equatorial plane from the Greenwich meridian to the point where the satellite orbit makes its south-north crossing of the equatorial plane ($0^\circ = j < 360^\circ$) | value != NULL && value >= 0 |
| keep_rnge | Number | 99.9 | Longitudinal tolerance of the longitude of the ascending node | If f_stn_keep == 'Y' then value != NULL && value >= 0 |

phase

| Data Item | Data Type | Format | Description | Validation |
|------------|-----------|--------|---|-----------------------------|
| ntc_id | Number | 9(9) | Unique identifier of the notice | Foreign Key |
| orb_id | Number | 99 | Sequence number of the orbital plane | Foreign Key |
| orb_sat_id | Number | 99 | Satellite sequence number in the orbital plane | value != NULL && value >= 0 |
| phase_ang | Number | 999.9 | Initial phase angle of the satellite in the orbital plane If RR No. 9.11A applies | value != NULL && value >= 0 |

freq

| Data Item | Data Type | Format | Description | Validation |
|-----------|-----------|-----------|---|---------------------------|
| grp_id | Number | 9(9) | Unique identifier of the group | Foreign Key |
| freq_max | Number | 9(6).9(6) | Maximum frequency in MHz (assigned frequency + half bandwidth) | value != NULL && value >0 |
| freq_min | Number | 9(6).9(6 | Minimum frequency in MHz (assigned frequency - half bandwidth) | value != NULL && value >0 |
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grp

| Data Item | Data Type | Format | Description | Validation |
|------------|-----------|-----------|---|---|
| ntc_id | Number | 9(9) | Unique identifier of the notice | Foreign Key |
| grp_id | Number | 9(9) | Unique identifier of the group | Primary Key |
| emi_rcp | Text | х | Code identifying a beam as either transmitting [E] or receiving [R] | value != NULL && (value == 'E' 'R') |
| beam_name | Text | X(8) | Designation of the satellite antenna beam | |
| elev_min | Number | S9(3).99 | Minimum elevation angle at which any associated earth station can transmit to a non-geostationary satellite or minimum elevation angle at which the radio astronomy station conducts single-dish or VLBI observations | value != NULL && value >= 0 |
| freq_min | Number | 9(6).9(6) | Minimum frequency in MHz (assigned frequency – half bandwidth) (of all frequencies for this group) | value != NULL && value > 0 |
| freq_max | Number | 9(6).9(6) | Maximum frequency in MHz (assigned frequency + half bandwidth) (of all frequencies for this group) | value != NULL && value > 0 |
| d_prot_eff | Date/Time | 9(8) | date of protection of the frequency group | |
| d_rcv | Date/Time | 9(8) | date of receipt of the list of frequency assignments pertaining to the group | |
| noise_t | Number | 9(6) | receiving system noise temperature | Only validated for 9.7A/B checks |

srv_cls

| Data Item | Data Type | Format | Description | Validation |
|-----------|-----------|--------|--------------------------------|--------------------------------|
| grp_id | Number | 9(9) | Unique identifier of the group | Foreign Key |
| seq_no | Number | 9(4) | Sequence number | value != NULL && value >= 0 |
| stn_cls | Text | XX | class of station | |

e_as_stn

| Data Item | Data Type | Format | Description | Validation |
|-----------|-----------|------------|--|---|
| grp_id | Number | 9(9) | Unique identifier of the group | Foreign Key |
| seq_no | Number | 9(4) | Sequence number | value != NULL && value >= 0 |
| stn_name | Text | X(20) | Name of the transmitting or receiving station | |
| stn_type | Text | Х | Code indicating if the earth station is specific [S] or typical [T] | value != NULL && (value == 'S' 'T') |
| bmwdth | Number | 999.99 | Angular width of radiation main lobe expressed in degrees with two decimal positions | value != NULL && value > 0 |
| lat_dec | Number | S9(3).9(4) | latitude in degrees with four decimals | value != NULL |
| long_dec | Number | S9(3).9(4) | longitude in degrees with four decimals | value != NULL |

sat_oper

| Data Item | Data Type | Format | Description | Validation |
|------------|-----------|----------|---|---------------|
| ntc_id | Number | 9(9) | Unique identifier of the notice | Foreign Key |
| lat_fr | Number | \$99.999 | Lower limit of the latitude range | value != NULL |
| lat_to | Number | \$99.999 | Upper limit of the latitude range | value != NULL |
| nbr_op_sat | Number | 9(4) | Maximum number of non- geostationary satellites transmitting with overlapping frequencies to a given location within the latitude range | value != NULL |

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mask_info

| Data Item | Data Type | Format | Description | Validation |
|-------------|-----------|-----------|--|---------------|
| ntc_id | Number | 9(9) | Unique identifier of the notice | Foreign Key |
| mask_id | Number | 9(9) | Unique identifier of the mask | Primary Key |
| freq_min | Number | 9(6).9(6) | The lowest frequency for which the mask is valid [GHz] | value != NULL |
| freq_max | Number | 9(6).9(6) | The highest frequency for which the mask is valid [GHz] | value != NULL |
| f_mask | Text | x | Flag indicating if the mask type is eirp for the space station [S], eirp for the associated earth station [E] or pfd at the space station [P] | value != NULL |
| f_mask_type | Text | X | Flag indicating the type of the mask. [A], alpha_deltaLongitude [X], X_deltaLongitude [Z], azimuth_elevation [O], EIRP masks | value != NULL |

mask_lnk1

| Data Item | Data Type | Format | Description | Validation |
|------------|-----------|--------|--|---|
| grp_id | Number | 9(9) | Unique identifier of the group | Foreign Key |
| seq_no | Number | 9(4) | Sequence number | value != NULL |
| ntc_id | Number | 9(9) | Unique identifier of the notice | Foreign Key |
| orb_id | Number | 9(4) | Sequence number of the orbital plane | value == NULL means all orbits for that ntc_id |
| sat_orb_id | Number | 9(4) | Satellite sequence number in the non- geostationary orbital plane | value == NULL means all satellites for that orb_id |
| mask_id | Number | 9(4) | Unique identifier of the group | Foreign Key |

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mask_Ink2

| Data Item | Data Type | Format | Description | Validation |
|------------|-----------|--------|--|---------------|
| grp_id | Number | 9(9) | Unique identifier of the group | Foreign Key |
| seq_no | Number | 9(4) | Sequence number | value != NULL |
| seq_e_as | Number | 9(4) | Sequence number of the associated earth station | value != NULL |
| ntc_id | Number | 9(9) | Unique identifier of the notice | Foreign Key |
| orb_id | Number | 9(4) | Sequence number of the orbital plane | Not Used |
| sat_orb_id | Number | 9(4) | Satellite sequence number in the non- geostationary orbital plane | Not Used |
| mask_id | Number | 9(4) | Unique identifier of the group | Foreign Key |

Tables used in the Article 9.7A/9.7B calculations

e_stn

| Data Item | Data Type | Format | Description | Validation |
|-----------|-----------|------------|---|---------------|
| ntc_id | Number | 9(9) | Unique identifier of the notice | Foreign Key |
| stn_name | Text | X(20) | Name of the earth station | value != NULL |
| sat_name | Text | X(20) | Name of the associated space station | value != NULL |
| lat_dec | Number | S9(2).9(4) | Latitude in degrees with four decimals | value != NULL |
| long_dec | Number | S9(2).9(4) | Longitude in degrees with four decimals | value != NULL |
| long_nom | Number | \$999.99 | nominal longitude of the associated space station, give'-' for West, '+' for East | value != NULL |

e_ant

| Data Item | Data Type | Format | Description | Validation |
|-----------|-----------|--------|---|---------------|
| ntc_id | Number | 9(9) | Unique identifier of the notice | Foreign Key |
| emi_rcp | Text | х | code identifying a beam as either transmitting [E] or receiving [R] | value != NULL |
| bmwdth | Number | 999.99 | beamwidth of the earth station antenna | |
| gain | Number | S99.9 | maximum isotropic gain of the earth station antenna | |
| ant_diam | Number | 999.99 | antenna diameter (meters): for FSS earth stations operating in the frequency band 13.75 – 14.0 GHz | |