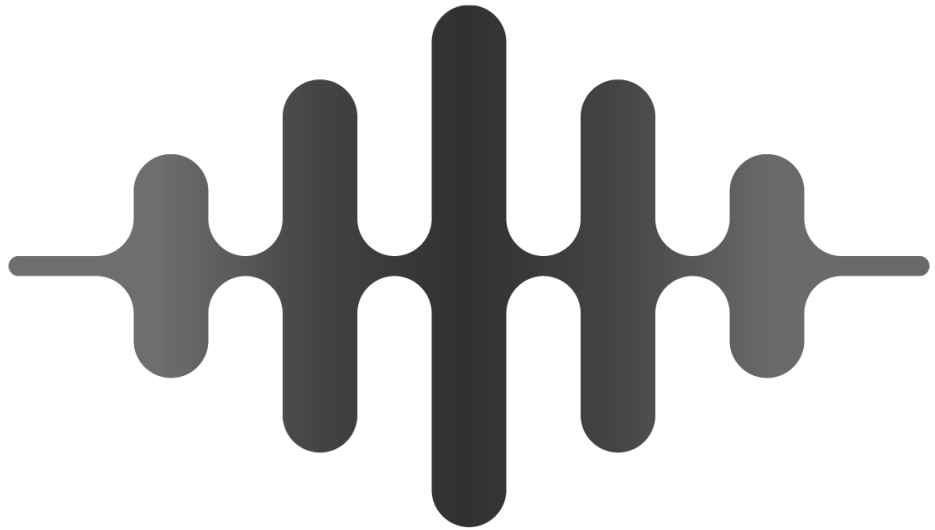


ITUWRS GENEVA2024

2–6 December 2024
Geneva, Switzerland

ITU World Radiocommunication Seminar

Equivalent power-flux density limits examination

2-6 December 2024, Geneva, Switzerland

Equivalent power-flux density limits examination

Part II – Capture of specific parameters for non-GSO systems subject to EPFD

Satellite networks subject to Nos. 22.5C, 22.5D, 22.5F, 22.5L (EPFD limits)

Frequency ranges (MHz)	Direction	Limits Information
3700 -4200	E	Article **22**, Table **22-1E**↓, BW: 4 kHz
5925-6725	R	Article **22**, Table **22-2**↑, BW: 4 kHz
10700 - 11700	E	Appendix **5**, Table **5-1**, No. **9.7B**↓, BW: 40 kHz
		Article **22**, No. **22.5C4**↓, BW: 40 kHz
		Article **22**, Table **22-1A**↓, BW: 40 kHz
		Article **22**, Table **22-3**↔, BW: 40 kHz
11700 - 12200	E	Appendix **5**, Table **5-1**, No. **9.7B**↓, BW: 40 kHz
		Article **22**, No. **22.5C4**↓, BW: 40 kHz
		Article **22**, No. **22.5C8**↓, BW: 40 kHz
		Article **22**, Table **22-1A**↓, BW: 40 kHz
		Article **22**, Table **22-1D**↓, BW: 40 kHz
12200 - 12750	E	Article **22**, No. **22.5C8**↓, BW: 40 kHz
		Article **22**, Table **22-1D**↓, BW: 40 kHz
		Article **22**, RR **22.5C4**↓, BW: 40 kHz
		Article **22**, Table **22-1A**↓, BW: 40 kHz
		Appendix **5**, Table **5-1**, No. **9.7B**↓, BW: 40 kHz
		Article **22**, Table **22-3**↔, BW: 40 kHz
12500 - 13250	R	Article **22**, Table **22-2**↑, BW: 40 kHz
13750 - 14500	R	Article **22**, Table **22-2**↑, BW: 40 kHz

Fixed-satellite service (FSS)
(or space operation functions)

↑ – Earth Station EIRP mask
(item **A.14.b** of Appendix **4**)

↓ – Space Station PFD mask
(item **A.14.c** of Appendix **4**)

↔ – Space Station EIRP mask
(item **A.14.a** of Appendix **4**)

Satellite networks subject to Nos. 22.5C, 22.5D, 22.5F, 22.5L (EPFD limits)

Frequency ranges (MHz)	Direction	Limits Information
17300 - 17700	E	Article **22**, Table **22-3↔**, BW: 40 kHz
		Article **22**, Table **22-1B↓**, BW: 40 kHz
		Article **22**, Table **22-1B↓**, BW: 1000 kHz
17300 - 18100	R	Article **22**, Table **22-2↑**, BW: 40 kHz
17800 - 18600	E	Article **22**, Table **22-3↔**, BW: 40 kHz
		Article **22**, Table **22-1B↓**, BW: 40 kHz
		Appendix **5**, Table **5-1**, No. **9.7B↓**, BW: 1000 kHz
		Article **22**, Table **22-1B↓**, BW: 1000 kHz
19700 - 20200	E	Article **22**, Table **22-1C↓**, BW: 40 kHz
		Appendix **5**, Table **5-1**, No. **9.7B↓**, BW: 1000 kHz
		Article **22**, Table **22-1C↓**, BW: 1000 kHz
27500 - 28600	R	Article **22**, Table **22-2↑**, BW: 40 kHz
29500 - 30000	R	Article **22**, Table **22-2↑**, BW: 40 kHz
37500 - 42500	E	Article **22**, No. **22.5L↓**, BW: 1000 kHz
47200 - 50200	R	Article **22**, No. **22.5L↑**, BW: 1000 kHz
50400 - 51400	R	Article **22**, No. **22.5L↑**, BW: 1000 kHz

Fixed-satellite service (FSS)
(or space operation functions)

↑ – Earth Station EIRP mask
(item **A.14.b** of Appendix **4**)

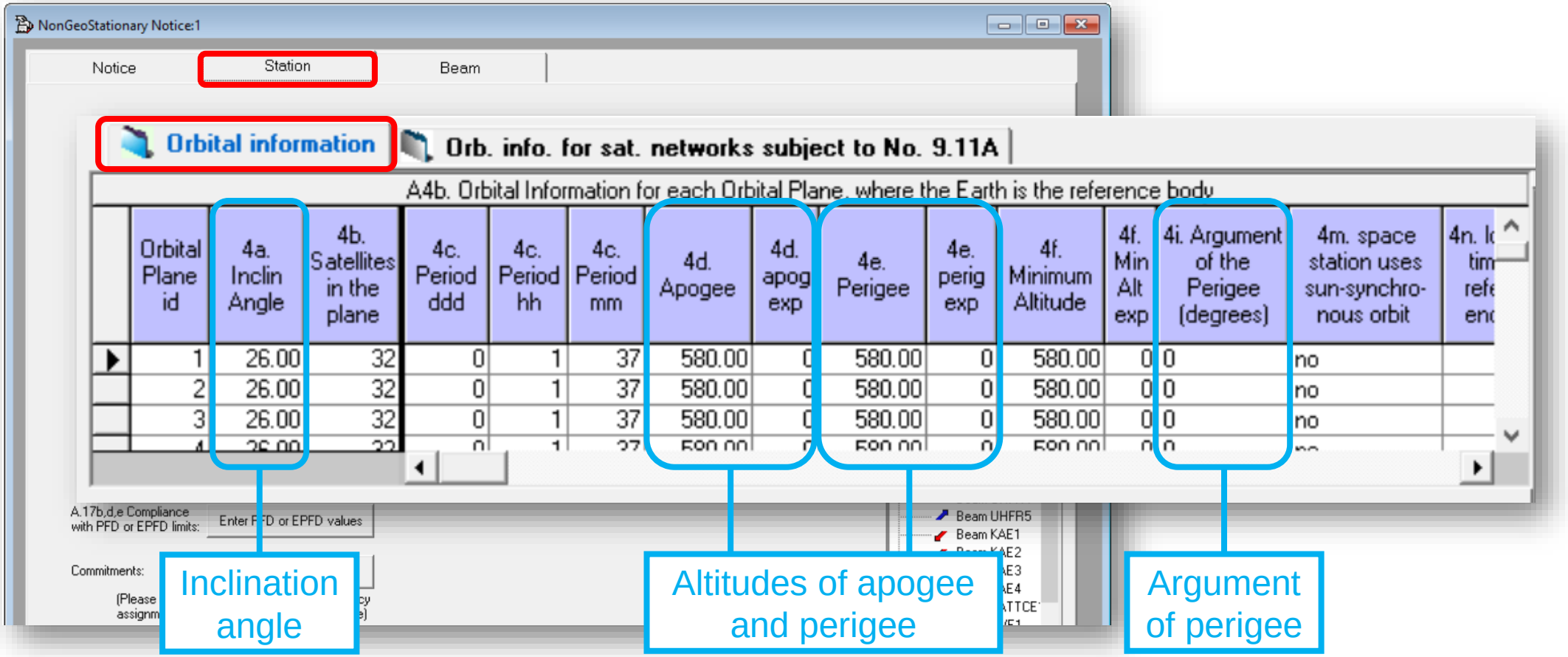
↓ – Space Station PFD mask
(item **A.14.c** of Appendix **4**)

↔ – Space Station EIRP mask
(item **A.14.a** of Appendix **4**)

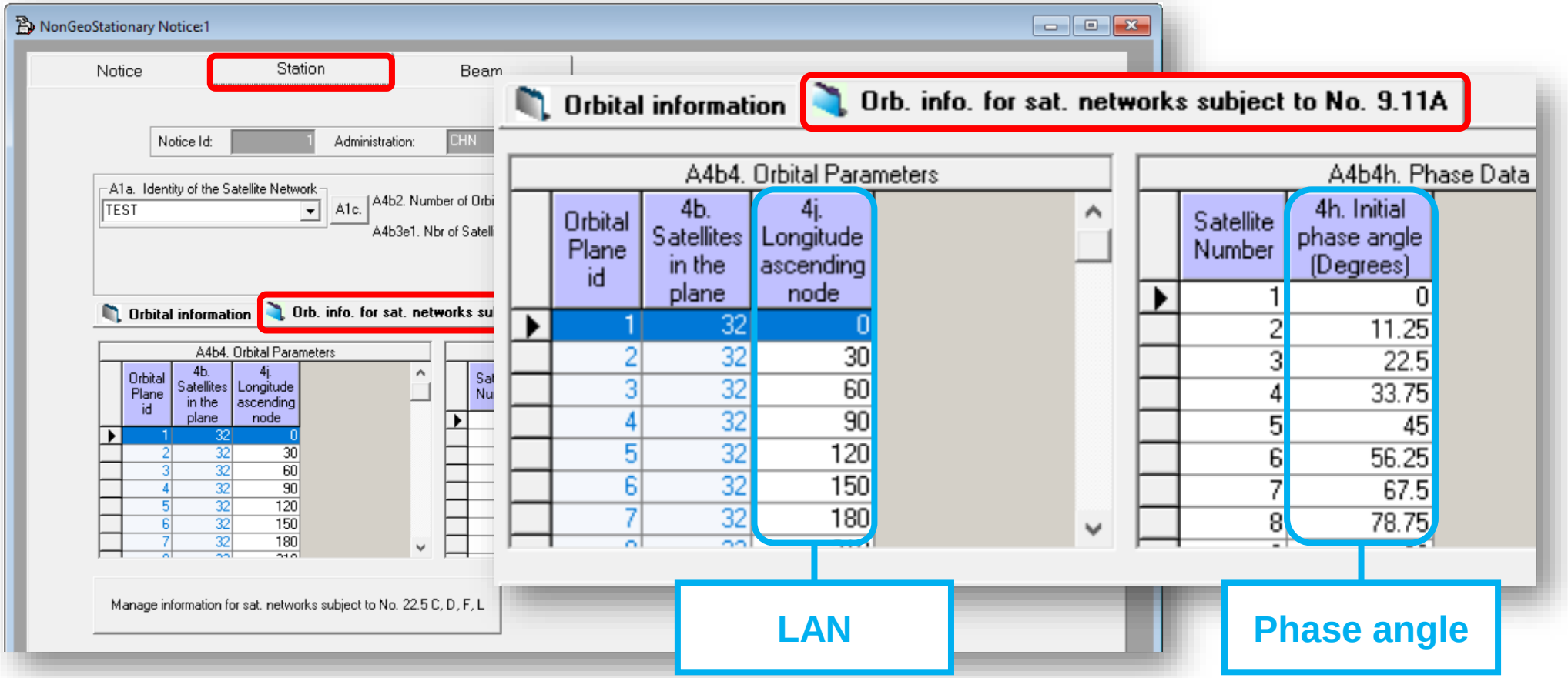
Mandatory orbital information for networks subject to EPFD limits

- **Inclination of orbit** (item A.4.b.4.a of Appendix 4)
- **Altitude of apogee** and **perigee**, **minimum operating height** (items A.4.b.4.d/e/f of Appendix 4)
- **Longitude of ascending node (LAN)** (item A.4.b.4.j of Appendix 4)
- **Phase angle** of the satellite within its orbital plane (item A.4.b.4.h of Appendix 4)
- **Argument of perigee** (item A.4.b.4.i of Appendix 4)

Mandatory orbital information for networks subject to EPFD limits



Mandatory orbital information for networks subject to EPFD limits



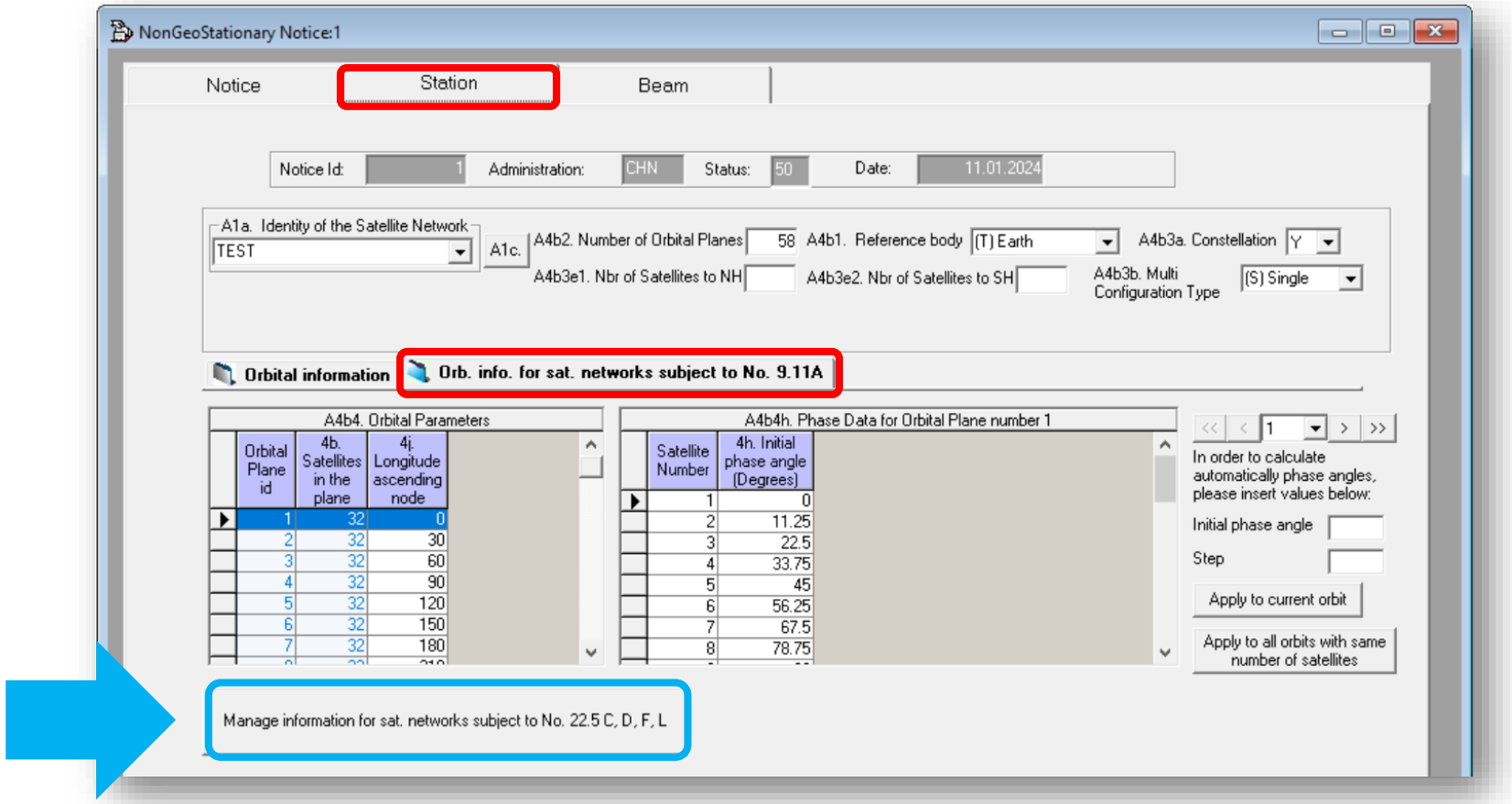
Mandatory orbital information for networks subject to EPFD limits

- Indicator showing whether the space station uses **station-keeping to maintain a repeating ground track** and, if yes, **the time (period)** for the constellation to return to its starting position (items A.4.b.6.c and A.4.b.6.d of Appendix 4)

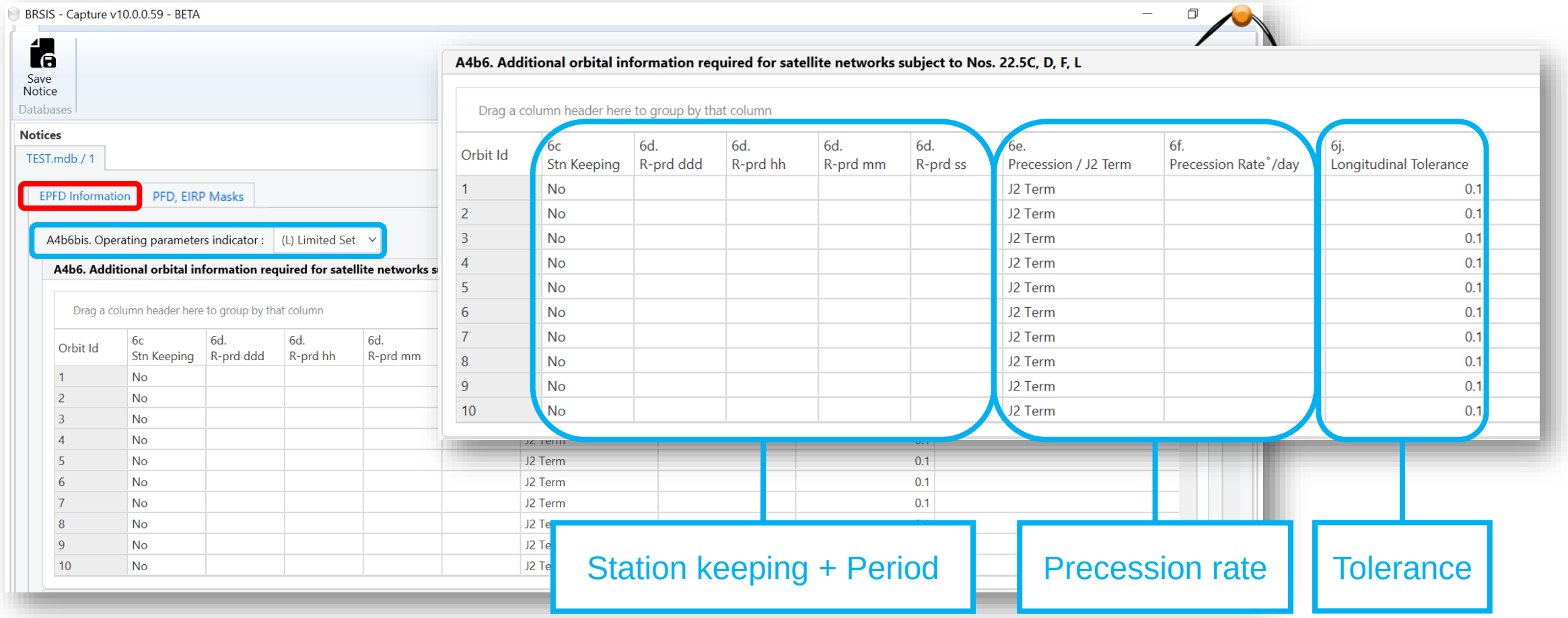
- Indicator showing whether the space station should be modelled **with a specific precession rate of the ascending node instead of the J2 term** and, if yes, **the precession rate (degrees/day),** measured counter-clockwise in the equatorial plane (items A.4.b.6.e and A.4.b.6.f of Appendix 4)

- **Longitudinal tolerance** of the LAN (item A.4.b.6.j of Appendix 4)

Mandatory orbital information for networks subject to EPFD limits



Mandatory orbital information for networks subject to EPFD limits



Mandatory AP4 items for networks subject to EPFD limits (limited set of operating parameters)

Earth-to-space direction:

- **Maximum number of non-GSO satellites receiving simultaneously (Nco)** with overlapping frequencies from the associated earth stations within a given cell (item A.4.b.7.a of Appendix 4)
- **Average number of associated earth stations** (1/km^2) with overlapping frequencies per square kilometre within a cell (item A.4.b.7.b of Appendix 4)
- **Average distance** (km) between co-frequency cells (item A.4.b.7.c of Appendix 4)

Limited set of operating parameters

Space-to-Earth direction:

- **Maximum number of non-GSO satellites transmitting with overlapping frequencies (Nco)** to a given location within the latitude range (item A.4.b.6.a.1 of Appendix 4)

Both directions:

- **Minimum elevation angle** at which any associated earth station can transmit to or receive from (item A.4.b.7.cbis of Appendix 4)
- **Type of zone (based on topocentric angle)** and the **width of the zone**, in degrees (items A.4.b.7.d.1 and A.4.b.7.d.2 of Appendix 4)

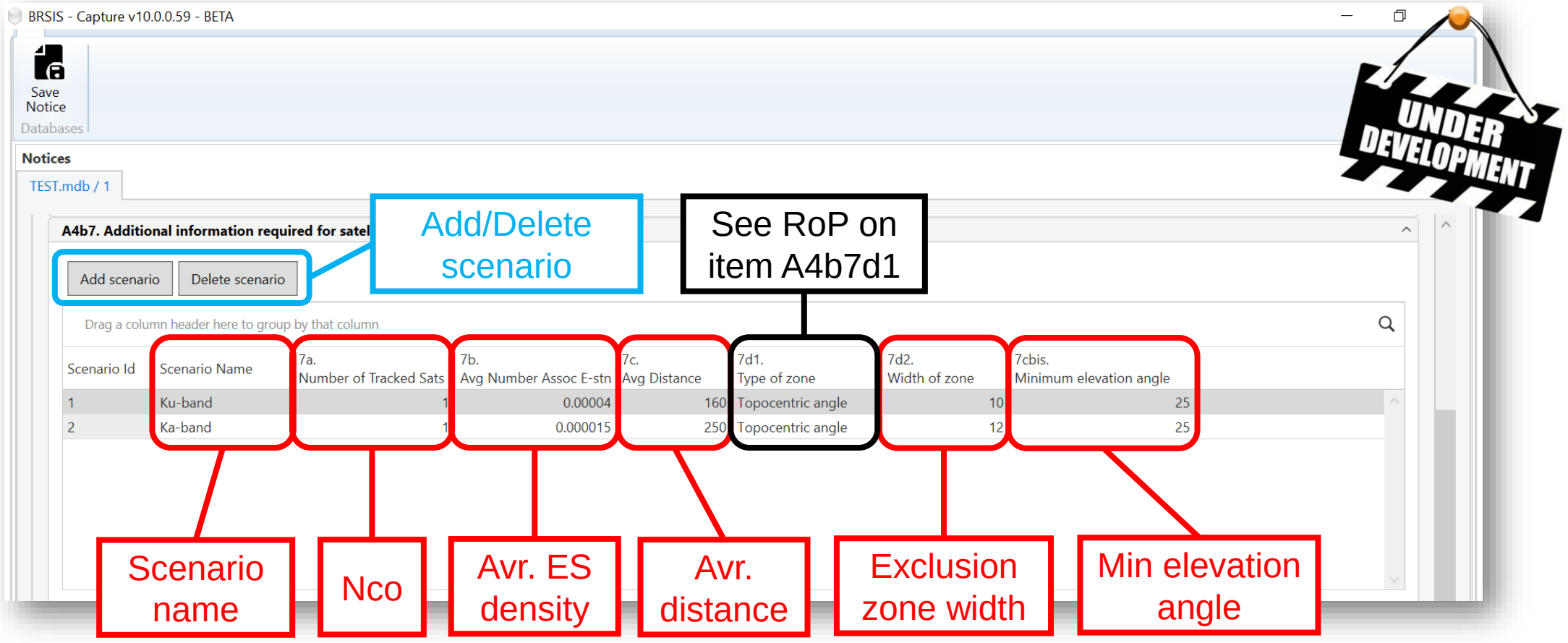
Scenarios for EPFD examination

1. **Different sets of operating parameters can be submitted for different frequency ranges** (only one set of operating parameters can be submitted for each frequency range)

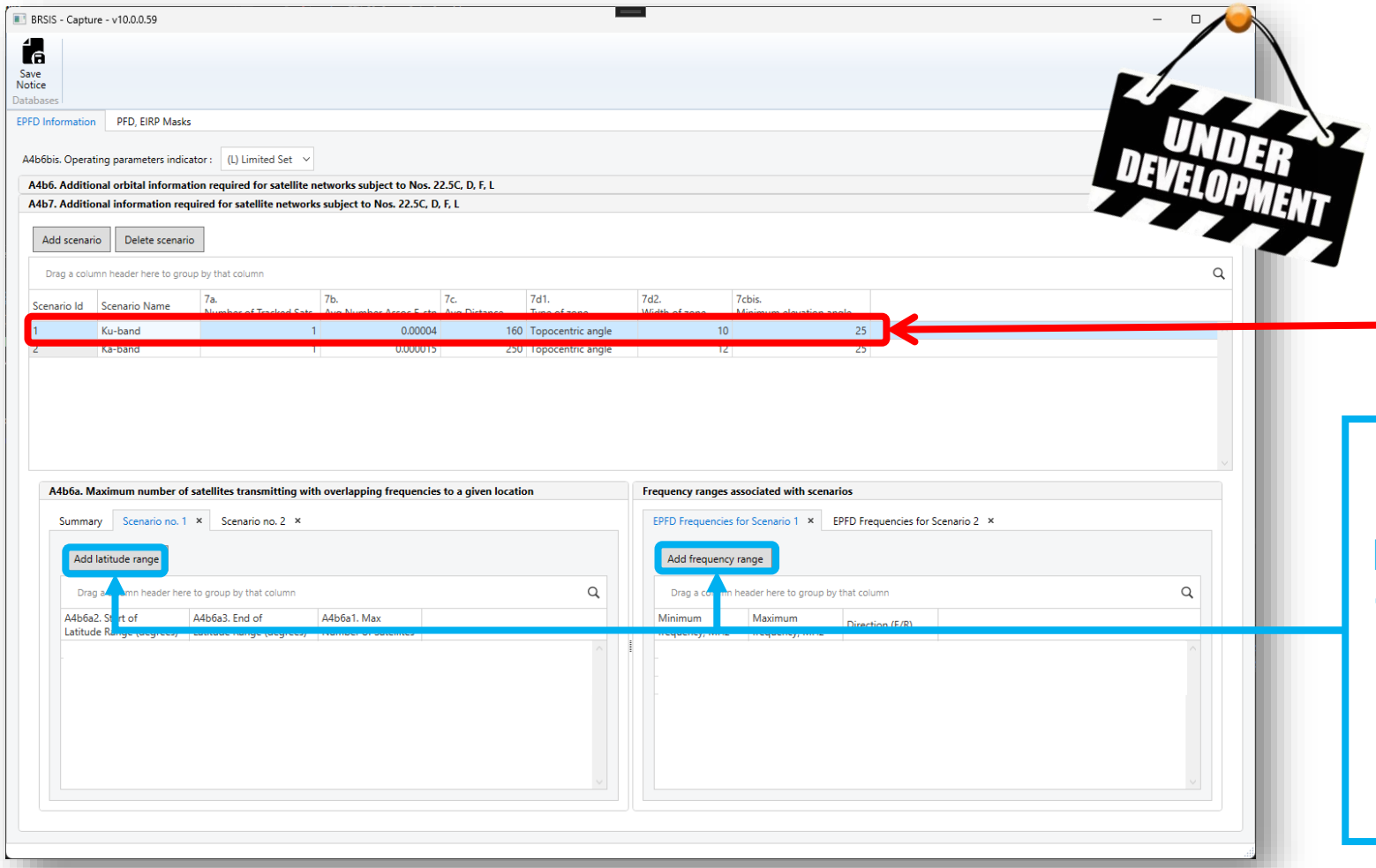
2. **“Examination scenario”** defines as an individual scenario sharing the same set of operating parameters applicable to specific frequency ranges

3. **Capturing of different “examination scenarios”** is now available in the new version of BR software **SpaceCap v.10.0**

Scenarios for EPFD examination



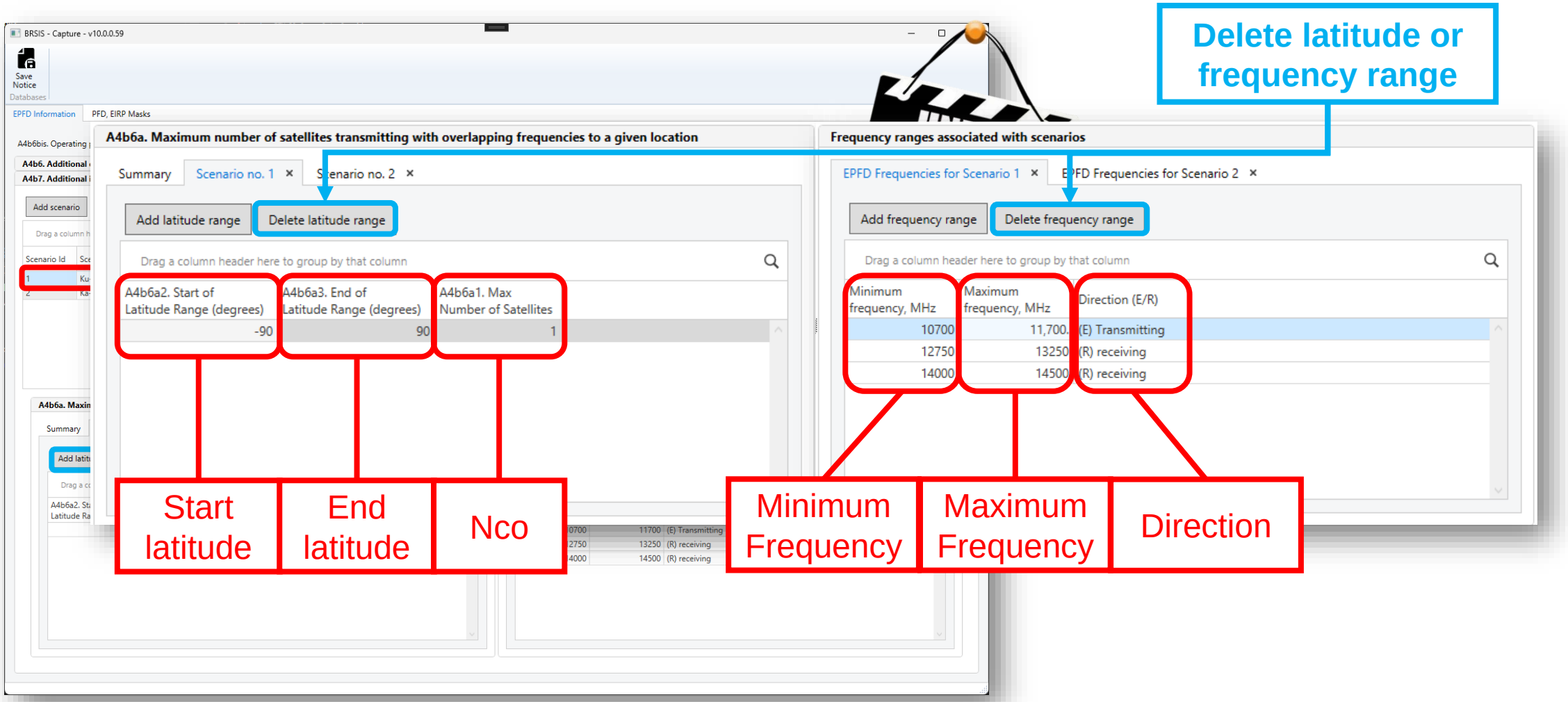
Scenarios for EPFD examination



Choose Scenario

Using the buttons “Add latitude range” and “Add frequency range” please provide additional information required for each Scenario

Scenarios for EPFD examination



EIRP, PFD masks in XML format

PFD mask for space station:

```xml
<?xml version="1.0" encoding="utf-8"?>
<satellite_system ntc_id="1" sat_name="TEST">
  <pfd_mask mask_id="1" low_freq_mhz="17700" high_freq_mhz="18600" refbw_khz="1000"
  type="azimuth_elevation" a_name="latitude" b_name="azimuth" c_name="elevation">
    <by
      <
      <
      <
    </b
    <by
      <
```

```xml
<?xml version="1.0" encoding="UTF-8"?>
<satellite_system ntc_id="1" sat_name="TEST">
  <pfd_mask c_name="deltaLongitude" b_name="alpha" a_name="latitude"
  type="alpha_deltaLongitude" low_freq_mhz="18000" high_freq_mhz="18600"
  mask_id="2" refbw_khz="40">
    <by_a a="-55">
      <by_b b="-90">
        <pfd c="-69">-1000.0000</pfd>
        <pfd c="-68">-136.1789</pfd>
        <pfd c="-60">-135.6897</pfd>
        <pfd c="-50">-135.0559</pfd>
        <pfd c="-40">-134.4230</pfd>
        <pfd c="-30">-133.8318</pfd>
        <pfd c="-20">-133.3382</pfd>
        <pfd c="-10">-133.0056</pfd>
        <pfd c="0">-132.8876</pfd>
        <pfd c="10">-133.0056</pfd>
        <pfd c="20">-133.3382</pfd>
        <pfd c="30">-133.8318</pfd>
        <pfd c="40">-134.4230</pfd>
        <pfd c="50">-135.0559</pfd>
        <pfd c="60">-135.6897</pfd>
        <pfd c="68">-136.1789</pfd>
        <pfd c="69">-1000.0000</pfd>
      </by_b>
```

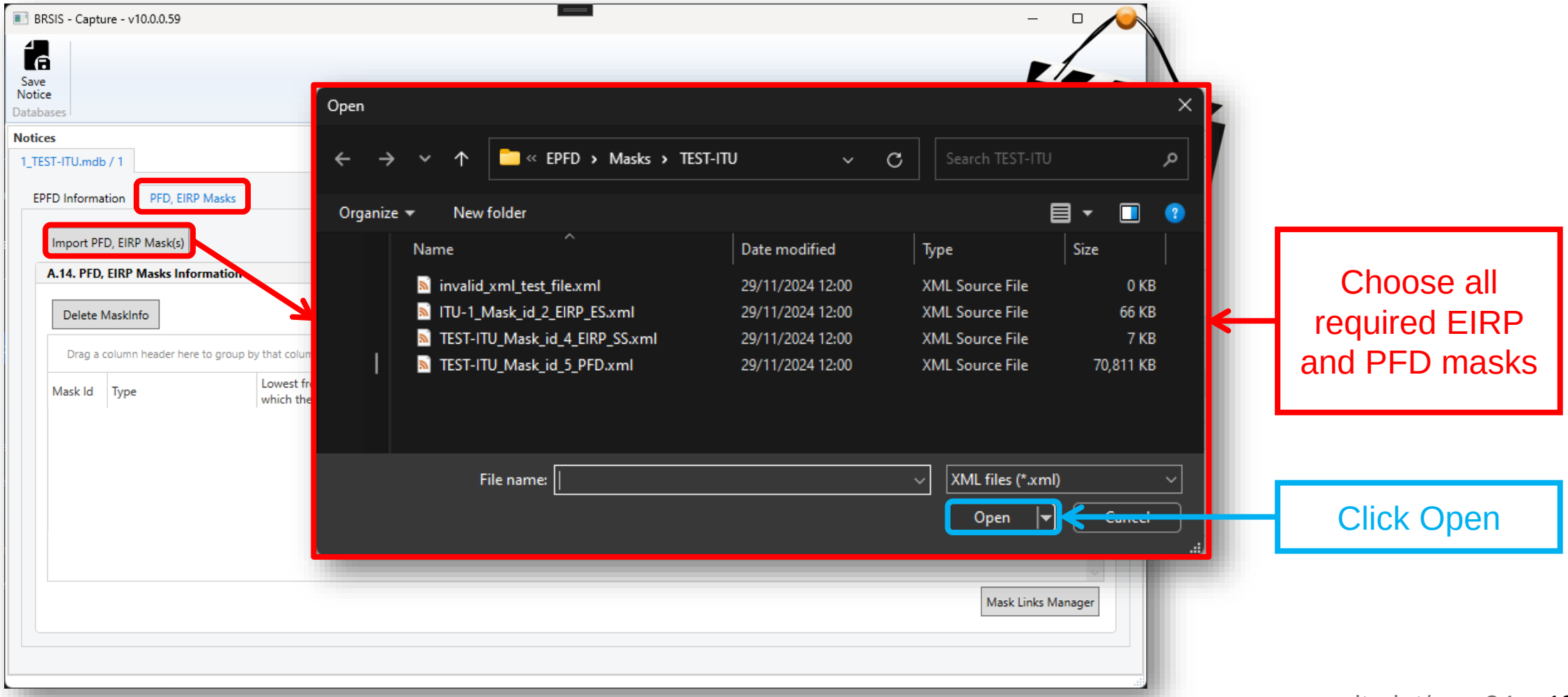
EIRP mask for earth station:

```xml
<?xml version="1.0" encoding="UTF-8"?>
<satellite_system ntc_id="1" sat_name="TEST">
  <eirp_mask_es mask_id="1" low_freq_mhz="17300" high_freq_mhz="18100"
  min_elev="5" a_name="latitude" d_name="separation angle"
  refbw_khz="40" ES_ID="-1">
    <by_a a="90">
      <eirp d="0">46</eirp>
      <eirp d="0.2">3.5</eirp>
      <eirp d="1">3.5</eirp>
      <eirp d="40">-22</eirp>
      <eirp d="180">-22</eirp>
    </by_a>
```

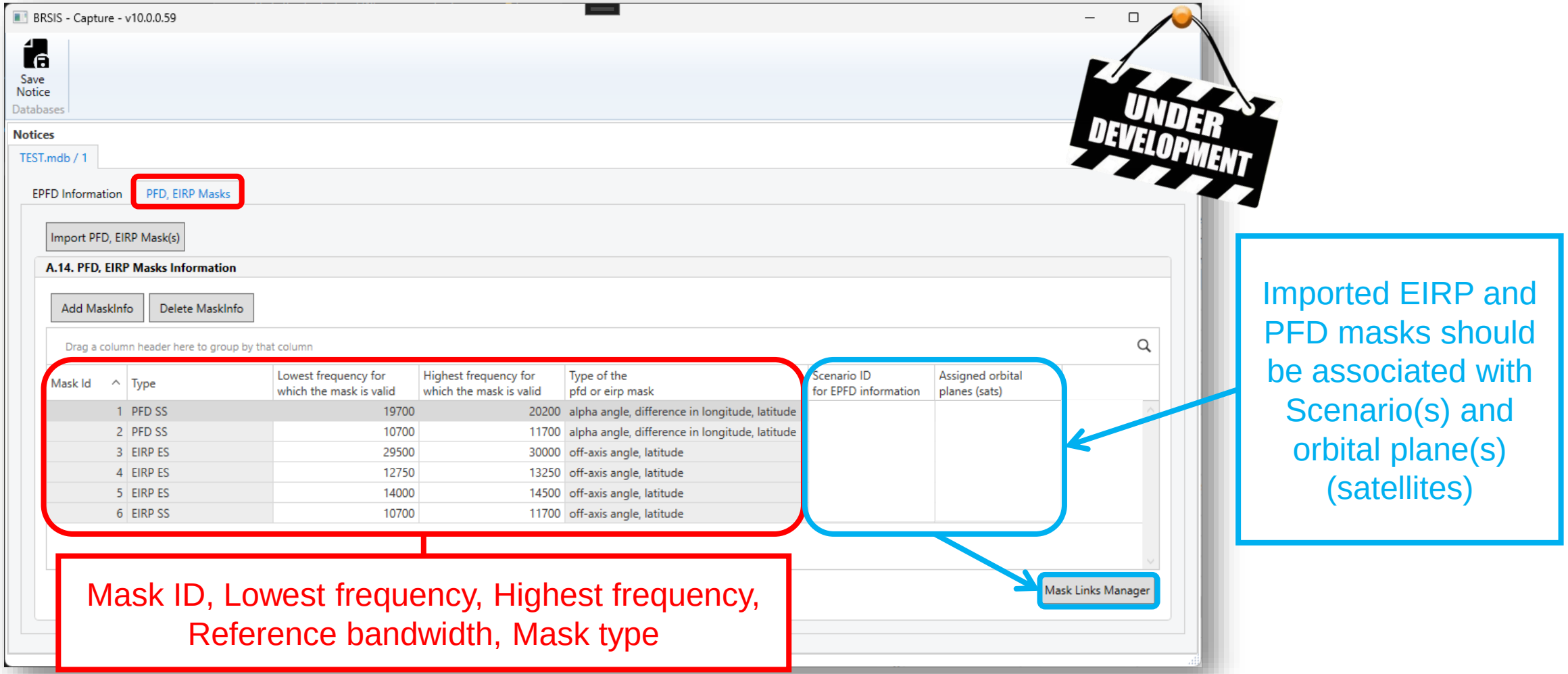
EIRP mask for space station:

```xml
<?xml version="1.0" encoding="utf-8"?>
<satellite_system ntc_id="1" sat_name="TEST">
  <eirp_mask_ss mask_id="3" low_freq_mhz="18000" high_freq_mhz="20200"
  a_name="latitude" d_name="separation angle">
    <by_a a="-55">
      <eirp d="0">19</eirp>
      <eirp d="20">19</eirp>
      <eirp d="21">8.55</eirp>
      <eirp d="31">-13.79</eirp>
      <eirp d="41">-20.81</eirp>
      <eirp d="51">-25</eirp>
      <eirp d="180">-25</eirp>
    </by_a>
    <by_a a="55">
      <eirp d="0">19</eirp>
```

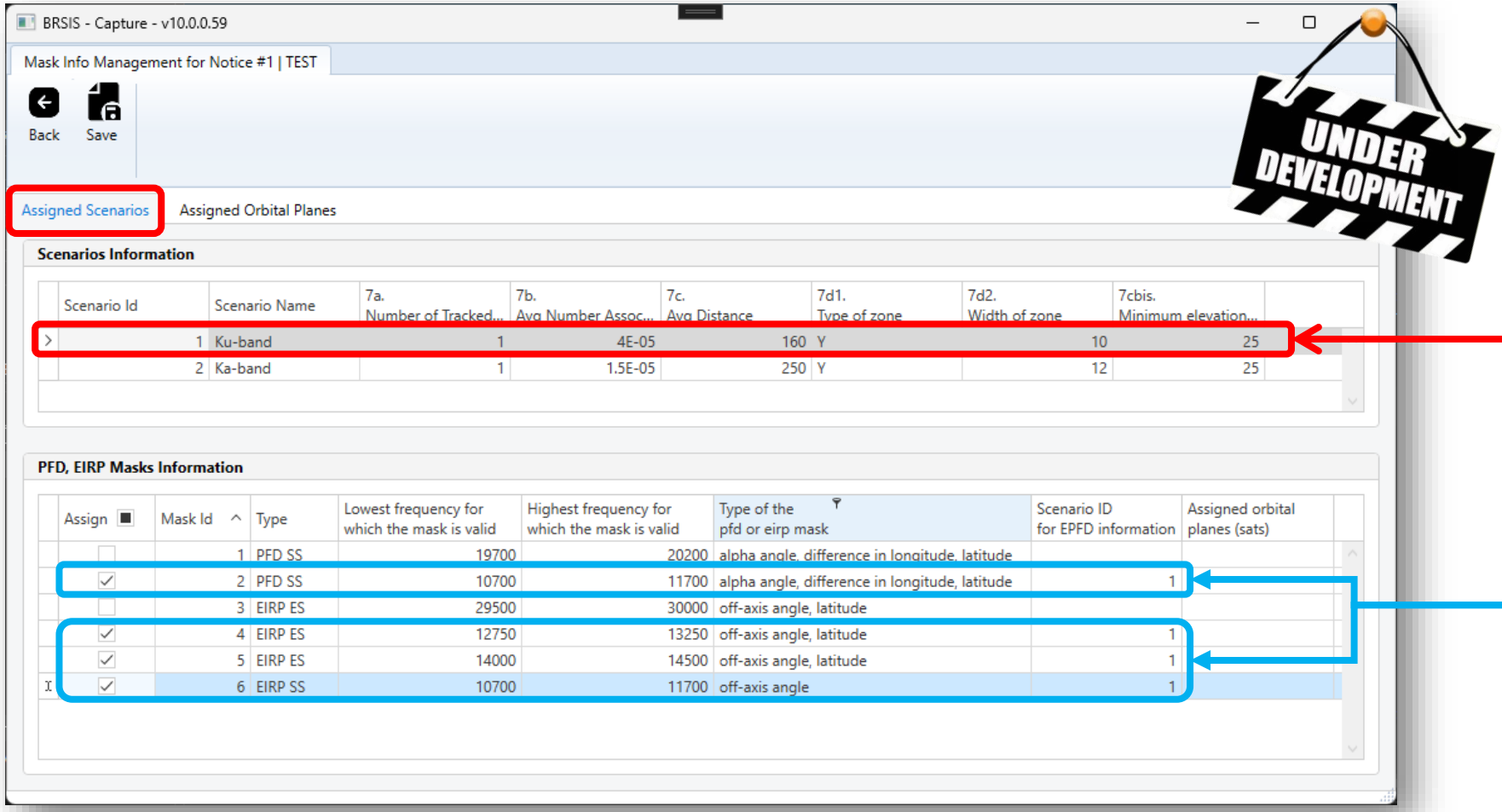
Import EIRP, PFD masks to SNS database



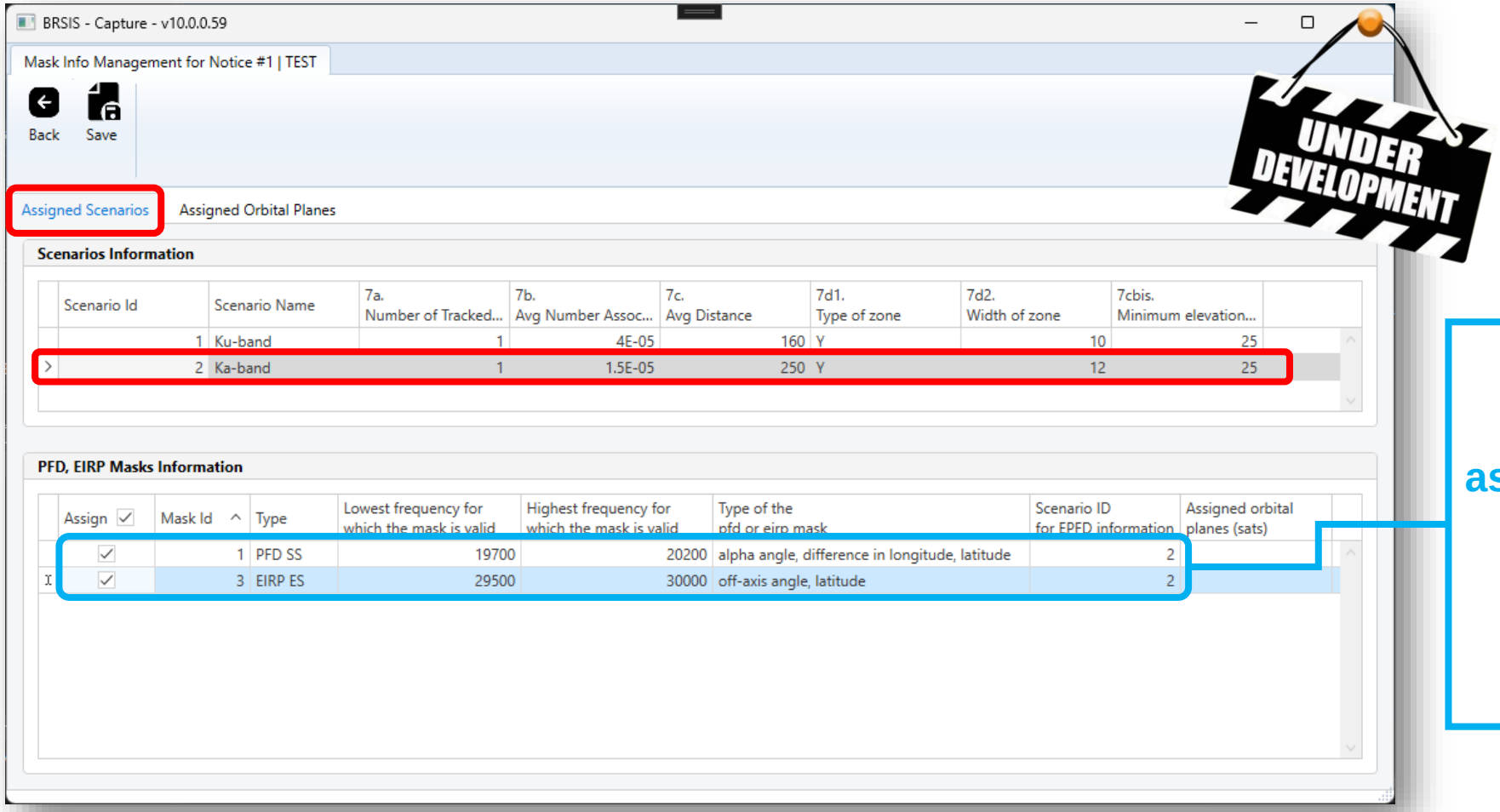
EIRP, PFD mask links



EIRP, PFD mask vs Scenario

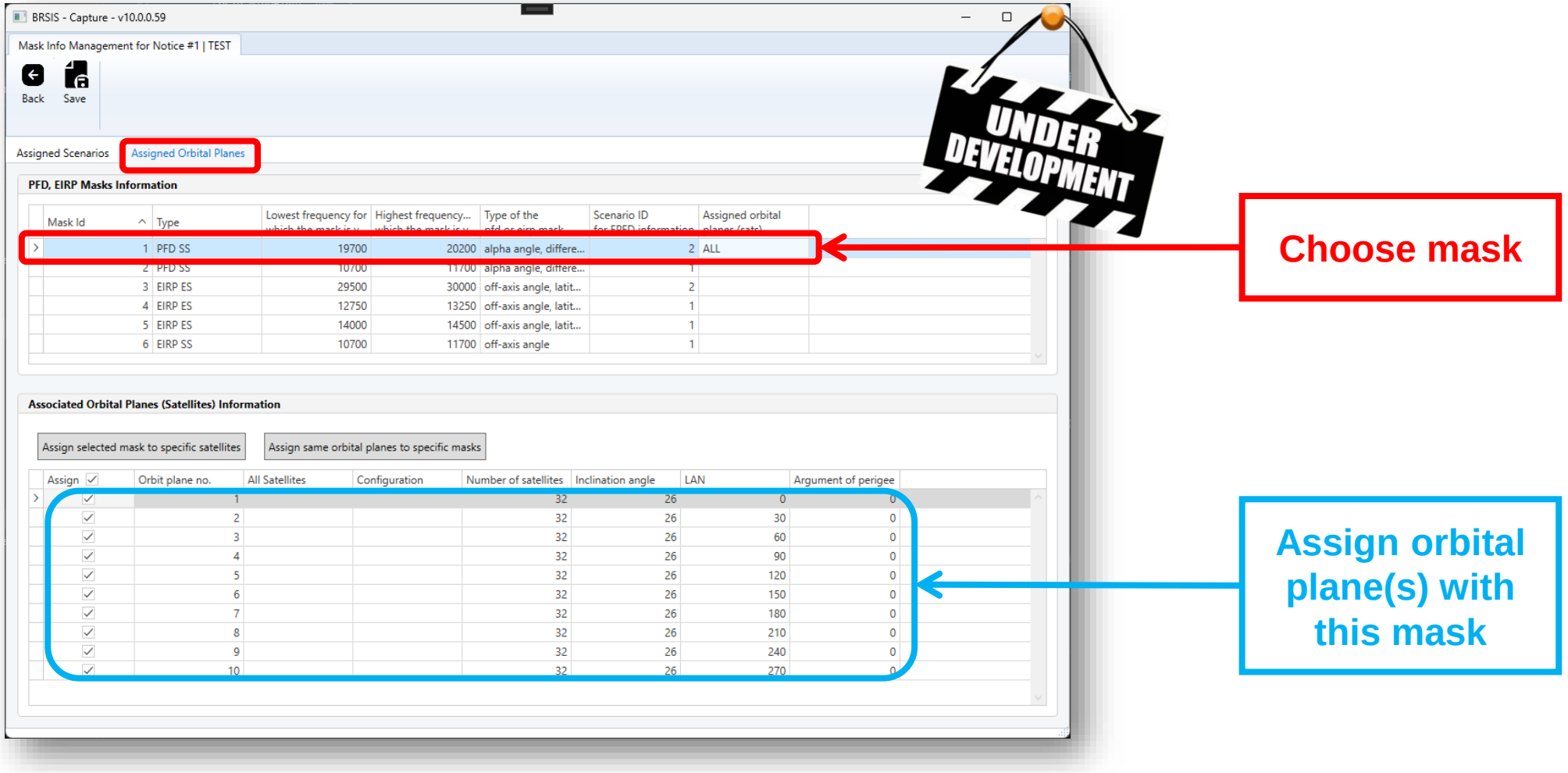


EIRP, PFD mask vs Scenario

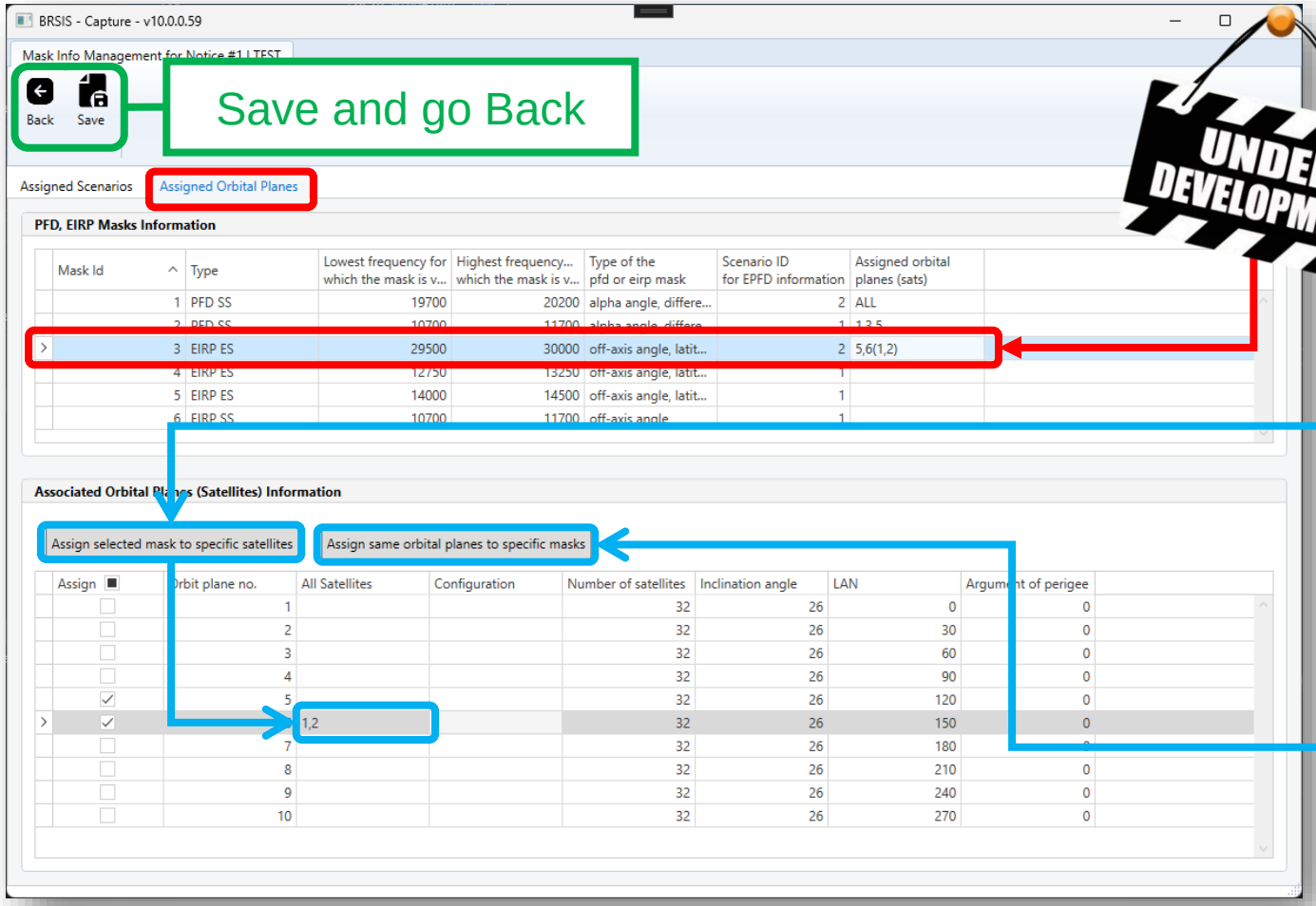


Since only one Scenario can be associated with each mask, for second Scenario only remaining masks will be shown

EIRP, PFD mask vs Orbital planes



EIRP, PFD mask vs Orbital planes

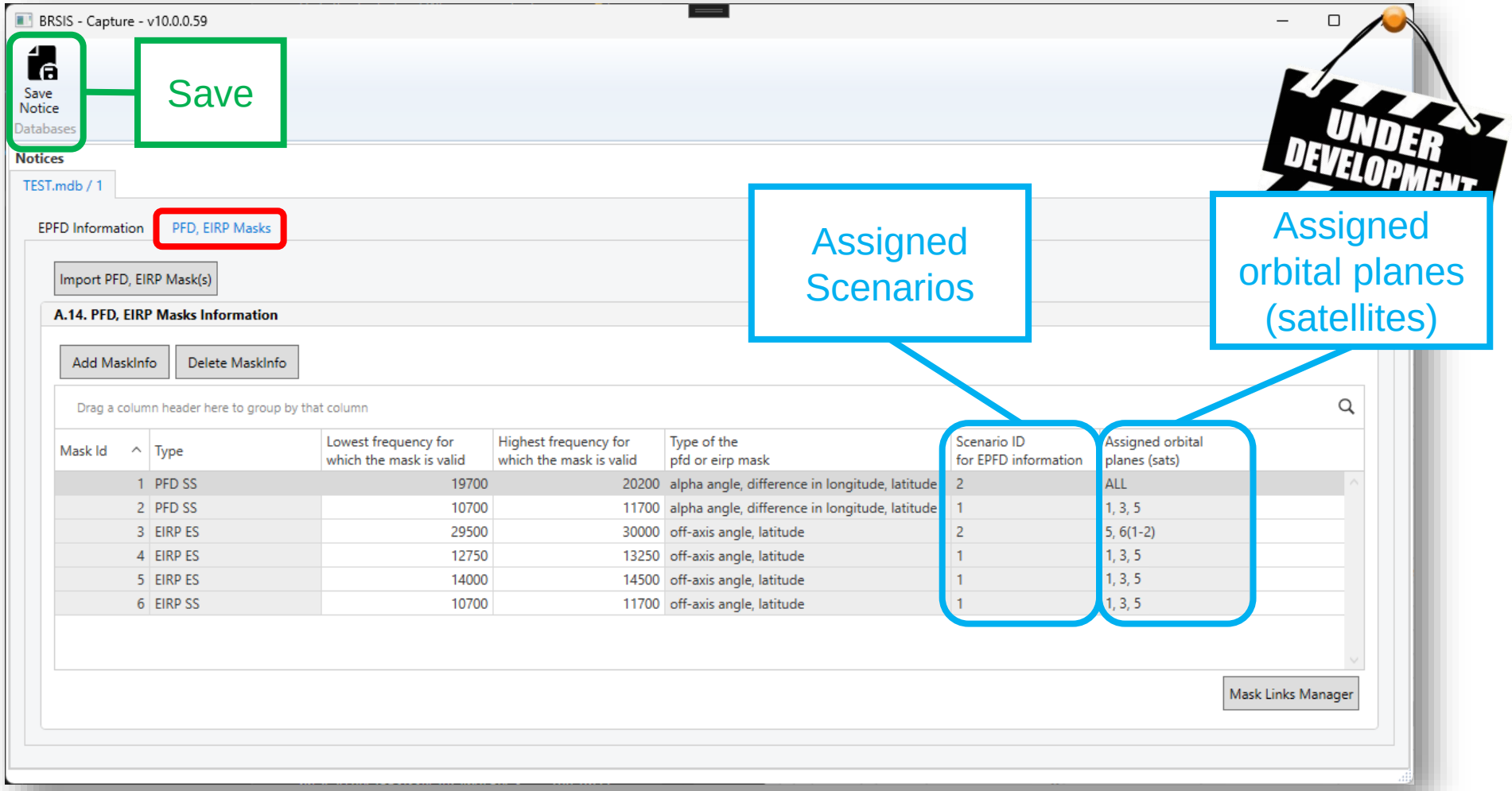


If only some satellites in orbital plane should be assigned

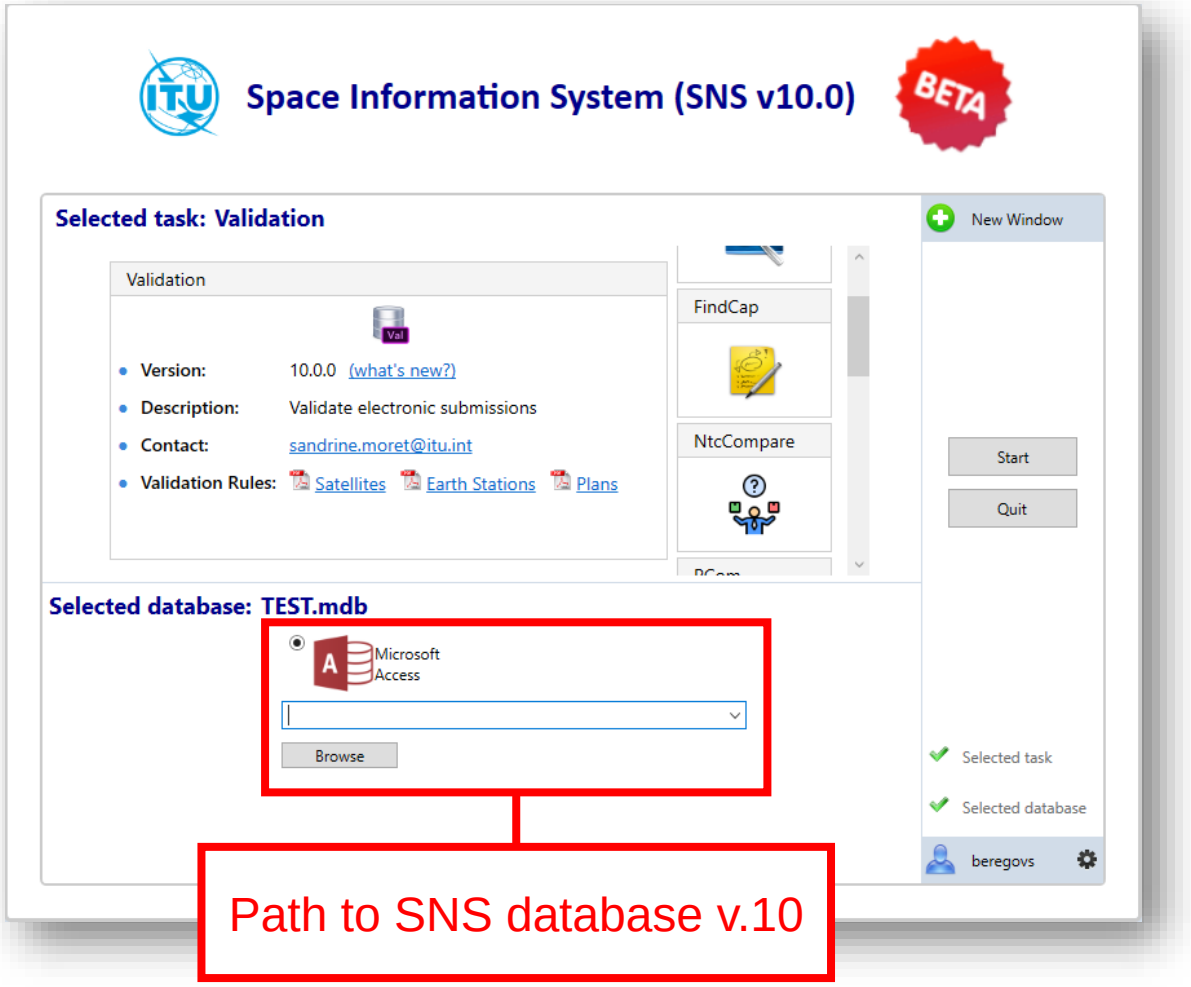
Function “Assign selected mask to specific satellites” should be used

There will be also function to assign the same orbital planes (satellites) to specified masks

EIRP, PFD mask links



BR-SIS Validation v10.0



Cross-validation option with BR-SIS Validation v10.0 will be available for validating the limited operating parameters for EPFD examination against the imported EIRP, PFD masks for non-GSO satellite systems

Thank you!

ITU – Radiocommunication Bureau

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