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Optimizing the initial and multispectral overflight configurations

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CTBTO PREPARATORY COMMISSION | PUTTING AN END TO NUCLEAR EXPLOSIONS

INTRODUCTION AND MAIN RESULTS

Overflights are an integral part of an OSI but are technically challenging as they involve deploying and integrating equipment configurations on potentially unfamiliar airframes.

By further optimising the initial and multispectral overflight configurations, installation times have decreased, in-flight operations have become more efficient, data quality has improved, and data processing is more streamlined.

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Introduction

While each inspection technique face their own set of challenges, none is as acute as those facing techniques permitted from an airborne platform. The basis of this assessment is the fact that the platform from which the airborne techniques will be performed maybe unknown to the inspection team until they enter the territory of the inspected state party. The variety of aircraft in terms of power outlets, hatch availability and type, aircraft fuselage materials, hardpoint type and distribution etc make the task of configuring airborne techniques for deployment challenging.

Hatch with sensor plate

External mount points

Developing airborne techniques must be seen through the prism of Treaty language, which refers to additional overflight equipment being "…portable, easily installed…".

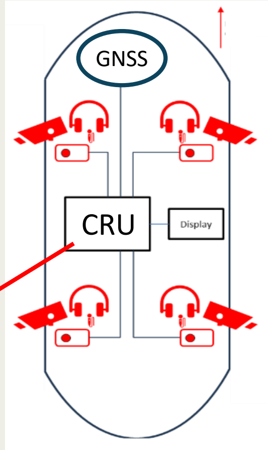
With these considerations in mind, the initial overflight (IOF) and the additional overflight (AOF) multispectral (MSIR) configurations have been reengineered to simplify installation, enhance ease-of-use, maximise capabilities as well as streamlining downstream data processing.

IOF

The IOF configuration is the simplest of the overflight (OF) configurations, involving binoculars, video cameras, hand-held still cameras and position finding equipment. Nevertheless, given that this is the only OF that the inspection team has the 'right to conduct' (*the others have to be negotiated*), the likely volume of data that it will return and its potential impact shaping search logic, it is critically important.

To facilitate IOF data acquisition and, as importantly, the integration and processing of data, a central recording unit was introduced on-board to provide a single source of position and store data from inspector terminals.

The configuration includes four dedicated handheld video cameras with audio recording possibility, each triggered independently by the inspectors onboard. The track, base map and recordings are displayed on individual inspector tablets with data stored centrally (CRU).



Schematic of the IOF configuration

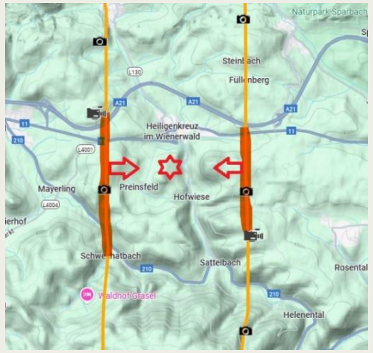
The CRU is housed in a rugged case and it, together with the video cameras and monitor are powered by the aircraft. The CRU receives position data from a GNSS antenna, which provides position information to each of inspector terminal. The entire IOF configuration can be installed in 30-45 minutes.

Monitor for field team leader/navigator

PDU

Inspector terminal

Case with CRU



To facilitate data processing, particularly correlating observations of the same features by different inspectors from different view points at different times, a tool is being developed for use in the Working Area at the Base of Operations

This together with other data processing tools will accelerate data processing and facilitate the generation of the relevant technical report.

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MSIR

Technically, the MSIR configuration is significantly more complex than IOF for a multitude of reasons, chief amongst these is the requirement to have unobstructed nadir field of view for the sensors. This requirement can be met by either installing sensors over a hatch in an airframe or using an external ‘belly’ or side-mounted pod. The latter options introduce potential additional certification requirements and aircraft engineer involvement in the installation process.

Pod with sensors installed on Bell412 helicopter

Certified aircraft engineer support is required for the installation of equipment, particularly for externally mounted devices and to access power systems

GNSS antenna

The reengineered MSIR configuration comprises dedicated imaging devices for the visible, near-infrared and thermal regions of the spectrum. The thermal imaging camera is a cooled photon detector sensing in the 2.0 – 5.5µm range. It also features a lidar and mechanical shutters triggered from inside the cabin. It also features a reconfigured display and control panel to facilitate data collection, and the data processing workflow has been enhanced through a custom, user-friendly application to pre-process data.

Three new imaging cameras

Uncluttered cabin arrangement

The base installation of the MSIR configuration is for the Bell212/412 helicopter, although the internal frame on which the sensors are installed can be adapted to meet other mid-size aircraft with hatches or pods, provided the juxtaposition of sensor optics and cut-outs can be aligned.

Testing

While bench- and ground-based vehicle testing play a valuable role in the development of airborne configurations, there is no substitute for in-flight operations. As part of the development process, the IOF and MSIR configurations have been installed in a variety of airframes. One outcome of testing has been to decrease the installation time for the MSIR configuration, which now stands at approximately two hours when installed on the Bell212 airframe.

Tests have provided valuable insights into software performance and workflows. Tests in 2025 revealed the need to refine both inflight and processing software for IOF data; these will be resolved prior to IFE26.

Conclusion

The reengineering work has been undertaken in compliance with the specifications listed in the First Comprehensive Draft List of Equipment for Use During On-Site Inspections (INF1573 rev1). These configurations will form the basis of those being deployed to IFE26; however, further customisation, particularly for MSIR, may be required depending on aircraft availability. The principle concern in this respect is the possibility of having to obtain a supplemental type certificate (STC), depending on the scale of the required modifications.