GEOLOGICAL SURVEY OF NORWAY (NGU)

FIXED WING STAVANGER-TRONDHEIM AEROMAGNETIC SURVEY 2013 (STAS-13)

FINAL SURVEY REPORT

Produced by:

EON GEOSCIENCES INC.

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1. Introduction

This report describes in detail the field operations, as well as the acquisition, verification, and processing steps required to obtain high quality final data through an airborne magnetic survey flown by **EON Geosciences Inc.** (**EON**) for the **Geological Survey of Norway** (**NGU**) on the mainland of western Norway, as part of their Stavanger-Trondheim Aeromagnetic Survey 2013 (STAS-13) project.

The STAS-13 survey was flown from Bergen Airport. Including initial calibrations and data acquisition, the airborne survey was realized between September 22nd to December 8th 2013 and January 28th to April 24th 2014. A total of 75,115 line kilometers were necessary to cover the STAS-13 survey area.

2. Survey Specifications

2.1. Survey Area

The survey area is located in western Norway. Its boundary is outlined in Figure 1. The boundaries for the survey area are defined by the coordinates found in Appendix A.

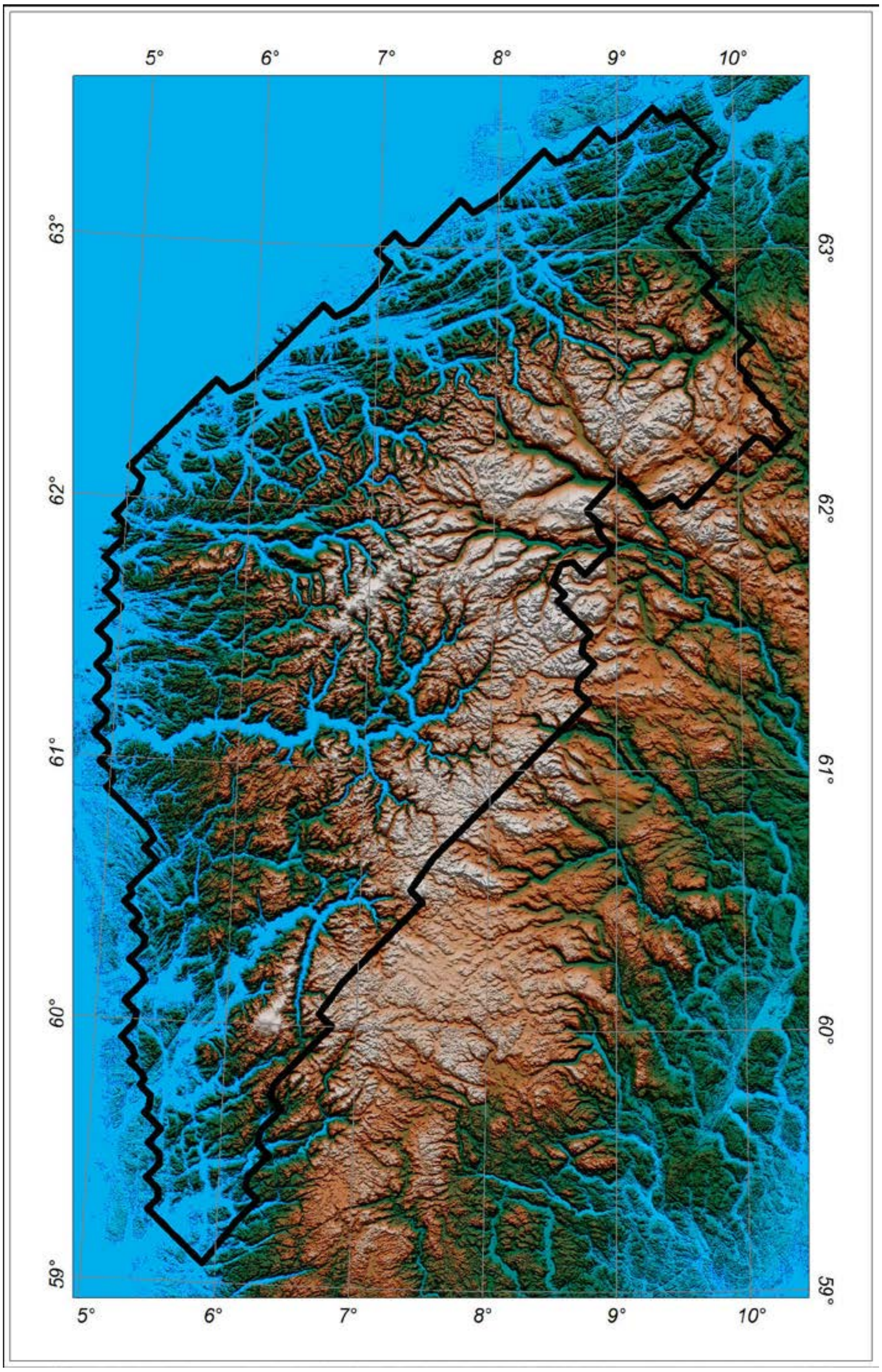

Figure 1: Location of the STAS-13 Survey

In terms of altitude, terrain in the survey area may be described as severe. Specifically, the topography ranges from 0 meter (sea level) to approximately 2,395 meters, and drops rapidly over the fjords.

2.2. Flight Specifications

2.2.1. Line Spacing

	Traverse Lines	Tie Lines	Total
Spacing	1,000 m	10,000 m	
Heading	N 135º E	N 45º E	
Line-km	67,911 km	7,204 km	**75,115 km**

2.2.2. Altitude

The survey was flown at a nominal terrain clearance of 200 meters.

In order to ensure that traverse and tie lines were flown at equal altitude at intersections, and in turn ensure a higher quality of levelled data, a drape surface contouring the topography was used for navigation. This drape surface was computed using the topography supplied by **NGU** and a slope of 5%.

2.3. Technical Specifications

Throughout the survey, the following technical specifications, as defined in the contract, were considered for data acceptance.

2.3.1. Flight Plan

In the absence of required avoidances for safety or regulatory reasons, the following items were considered for potential re-flight, according to their impact on end-product quality:

- Horizontal deviation with respect to the planned flight path causing line separations in excess of ±50% of the nominal spacing over a distance greater than 3,000 meters,
- Intervals displaying sustained deviation from the drape surface in excess of ±30m (ties) or ±50m (traverses).

2.3.2. Diurnal Activity

Tolerances for diurnal activity were:

- Intervals where main base station data displayed sustained deviations greater than ±30nT with respect to a 10-minute long-chord were considered as potential re-flights.

2.3.3. Airborne Magnetometer Noise

Tolerances for airborne total magnetic field (TMF) noise were:

- Intervals where airborne TMF data displayed sustained noise greater than an envelope of ±0.1nT, as determined by a 4th difference filter, were considered as potential re-flights,
- Standard figure of merit (FOM): better than 1.5 nT.

3. Survey Equipment and Personnel

3.1. Aircraft

EON provided a Piper Cheyenne II PA-31T aircraft (registration C-GFON) for this project (see Figure 2 below). The aircraft is equipped with a tail stinger suitable for one magnetometer.

The technical specifications are:

Type:	Piper Cheyenne II PA-31T
Registration:	C-GFON
Range (km):	2,000
Survey speed (km/h):	288
Survey speed (m/s):	80
Rate of climb (%):	15
Aviation Fuel:	Jet-A
Fuel consumption (L/hr):	250

Picture by Jan Einar Fardal

Figure 2: C-GFON – Survey Aircraft

3.2. Airborne and Ground Systems

EON used the latest state-of-the-art technology instruments as described in the following sections.

3.2.1. Magnetometer

A Geometrics G822-A cesium-vapour split-beam sensor was used. The specifications are as follows:

Manufacturer:	Geometrics
Type and Model:	G822-A
Ambient Range (nT):	20,000 – 100,000
Sensitivity (nT):	± 0.0006
Absolute Accuracy (nT):	± 3
Sampling Interval (sec):	0.1
Heading Error (nT):	± 0.025

3.2.2. Data Acquisition System and Compensator

EON used RMS Instruments' Data Acquisition & Adaptive Aeromagnetic Real-Time Compensation (DAARC500) system. This data acquisition system integrates aeromagnetic real-time compensation with recording from analog and serial data sources. All data acquisition is synchronized in real-time to GPS time via a 1 second pulse. Since the GPS position and UTC time are related to the GPS pulse, a correlation precise to ±0.015 sec is maintained.

DAARC500 compensation uses a three-axis fluxgate magnetometer to monitor the aircraft's position and motion with respect to the ambient magnetic field. Resulting signals are compensated according to a calibration based on a set of standard manoeuvres of rolls, pitches, and yaws made along each survey heading. Aeromagnetic data are sampled at a rate of 10Hz.

Analog and serial inputs are sampled at the same rate as magnetometer data, or at sub-multiples of it. These data are recorded in the main data file as a sequence of blocks including system and GPS times, as well as PPS-correlation event tags, in order to allow an easy quality control of synchronization.

This system provides a high-resolution real-time graphical output to a built-in colour display that allows real-time monitoring of data acquisition by the operator.

3.2.3. Navigation

The following table describes the airborne differential GPS system that provided both real-time navigation and flight-path recovery:

GPS Manufacturer:	NovAtel
Model:	ProPak-V3
Differential System:	Omnistar
Frequencies:	2
Accuracy (m):	± 1
Number of Channels:	12
Navigation System:	Ag-Nav LiNav
Pilot Display:	LCD with up/down and left/right indicators
Sampling Interval (sec):	1

The main features of the positioning system are:

1) Real-time graphical and numerical display of flight path with survey-area and grid-line overlay using real-time differentially corrected GPS data,
2) Vertical navigation with respect to a drape surface,
3) Distance-from-line and distance-to-go indicators,
4) Operation in survey-grid or way-point navigation mode,
5) Recording of raw range-data for all satellites.

3.2.4. Radar Altimeter

The following table describes the radar altimeter that was installed in the aircraft:

Manufacturer:	Rockwell Collins
Model:	ALT-55B
Range (ft):	0 to 2,500 ft
Accuracy:	± 2 ft (0-100 ft) ± 2 % (100-2,500 ft)
Sampling Interval (sec):	0.1

3.2.5. Pressure and Temperature Sensor

The following table describes the pressure and temperature sensors that were installed in the aircraft:

Manufacturer:	Vaisala	Vaisala
Model:	PTB110	HMP155
Measured parameter	Real atmospheric pressure	Ambient air temperature
Accuracy:	± 0.3 hPa (mbar)	± 0.17 °C
Sampling Interval (sec):	0.1	0.1

3.2.6. Magnetic Base Station

The following table describes the base station magnetometers that were installed at two different locations in Bergen, baseA and baseB. Figure 3 shows the baseA installation.

Manufacturer:	GEM Systems
Type:	Overhauser
Model:	GSM-19
Dynamic Range (nT):	10,000 – 120,000
Sensitivity (nT):	< 0.015
Absolute Accuracy (nT):	± 0.1
Sampling Interval (sec):	1
Noise level	< 0.1 nT

Figure 3: Magnetic Base Station A Installation

3.2.7. Field Data Quality Control System

The following list describes the main components of the in-field data verification system:

Computers:	PC laptops
Printer:	HP Photosmart C3180
Software:	Geosoft Oasis montaj, Waypoint GrafNav
Data transmission:	FTP site

Any calibrations or determinations that were carried out during the field operation were also processed on this system together with the daily quality control tests and checks.

3.3. Personnel

The following table lists the personnel of **EON** that were involved during this project:

Field Operation	
Project Manager	Khaled Moussaoui
Field Manager Operation Geophysicist Quality Control and Data Processing	Rick Bailey Soroor Mohammadi Maxime Salman
Pilots / Co-pilots / Equipment Operators	Alain Charron Raymond Fromm André-Philippe Camitsis François-Xavier Pinte
Aircraft Maintenance Engineer	Alain Guillemette
Office Processing	
Final Data Processing	Gérard Tessier
Survey Report	Khaled Moussaoui Gérard Tessier
Final Products	Khaled Moussaoui Gérard Tessier

4. Field Operations

4.1. Base of Operations

The survey was conducted from Bergen, Norway. The Bergen Airport was used as a base of operation. During the last month of the survey, the aircraft and crew temporarily relocated to different airports, namely Ålesund, Florø, and Førde, and also used various airports for refueling, namely Ålesund, Florø, Førde, Kristiansund, Molde, Sogndal, and Trondheim, thus minimizing ferry distance and maximizing production.

4.2. Schedule

The table below displays the schedule of survey activities including tests, calibrations, and demobilization. Data acquisition was completed on April 24th, 2014, for a total accepted production of 75,115 line-km.

Schedule – STAS-13 Survey – Norway		
Aircraft	**Date**	**Description**
Piper Cheyenne II PA-31T (C-GFON)	September 13th, 2013	C-GFON begins ferry flight from Montreal.
	September 19th, 2013	C-GFON arrives in Bergen.
	September 20th, 2013	Base stations installed in Bergen.
	September 22nd, 2013	Successful FOM test, flown offshore, western Norway.
	September 23rd, 2013	Production flying begins.
	October 19th, 2013	GPS base station destroyed by a herd of sheep.
	October 21st, 2013	baseA relocated away from sheep.
	October 24th, 2013	baseA relocated away from sheep.
	December 8th, 2013	Crew demobilized from Norway. Project halted due to poor weather conditions and shortening daylight.
	January 28th, 2014	Crew re-mobilized to Norway.
	January 29th, 2014	Base stations re-installed in Bergen.
	January 31st, 2014	Successful FOM test, flown offshore, western Norway.
	February 1st, 2014	Production flying resumes.
	April 24th, 2014	Data acquisition completed.
	April 26th, 2014	Demobilization begins.

4.3. Operational Issues

Production was operationally efficient from late September to early November 2013 and from late March to late April 2014, when two (2) sorties per day could often be performed. Late fall and winter were characterized by long idle periods without production, due to weather conditions. The major factors affecting production were:

- Weather, including low ceilings, fog, rain, and high winds, most notably toward the end of fall and during winter, and amounting to 109 down days (61% of total survey duration).

- Weather was also the sole cause of re-flights (2.4% of flown km), all due to deviation from drape and/or flight path, and of the breaking of close to 190 survey lines in multiple overlapping segments (3.9% of flown km).

- National security authorities designated as no-fly zones several segments of the original survey area, with the removal of 144 km and the following coverage disruptions:
  - 9 shortened traverses: 1390, 1710, 1750, 1910, 2030, 3300, 4410, 4650, 4990,
  - 10 traverses broken in two (2) sections: 2000, 2010, 2020, 2430, 3190, 3200, 3210, 3220, 4500, 5280,
  - 4 displaced ties: 6020, 6080, 6150, 6160.

- Difficulty in finding an adequate location for the magnetic base stations, as a background high-frequency noise was observed at all attempted sites in the general Bergen area.

- Several base stations location changes due to the destruction of the 1st installation by a herd of sheep and the relocation of the base stations at re-mobilization.

These issues are identified in the daily operational report found in Appendix D.

4.4. Tests and Calibrations

Prior to production flights, the following tests and calibrations were performed by the Piper Cheyenne II PA-31T aircraft (C-GFON) in the Montreal area and in Norway:

- Altimeter calibration
- Figure of Merit (FOM)

Detailed compilations for those tests are presented in Appendix B.

5. Data Processing

The key objective of this survey was the acquisition and processing of airborne total field magnetic (TMF) data. Preliminary field quality control and final data processing were performed using Geosoft Oasis montaj. In the following text, final database *channel names* are printed in *italics*, and a description of these channels may be found in Appendix C.

5.1. Map Projection

The following mapping projection was used throughout the project for navigation, data processing, and mapping purposes:

- Projection: UTM Zone 32N
- Type: Transverse Mercator
- Datum: WGS-84
- Reference ellipsoid: WGS-84
- Local datum transform: WGS-84 World
- Length unit: Meters

5.2. Field Processing and Quality Control

The field crew provided the field processor with backups of ground-based and airborne data files, either after each flight or on a daily basis, allowing for immediate quality control (QC) and initial data processing as described in the following. Field processing was entirely reviewed by the senior processor, either on a daily basis (flights 058-081 and 097-116), or at a later date (flights 001-054, 082-096, and 117-119).

Acquired data files were first merged into Oasis data files (GDB) in full flight format, on which the following basic QC and processing operations were performed on a daily basis:

- inspection of the flight path for completeness of coverage and compliance to line-spacing and altitude specifications,
- trimming of the *line* channel in order to provide four (4) seconds of extension outside of the survey boundary and preserve a maximal length of usable overlapping data, in-spec or not, useful for the determination and assessment of final processing parameters,
- statistical analysis and inspection, both in profile and grids, of key channels in order to ascertain compliance to diurnal and noise specifications (as described in Section 2.3), as well as to detect eventual operational issues requiring immediate action, such as missing data or hardware problems,
- logging of lines or segments of line possibly requiring re-flight, evaluation of their impact on general end-product quality via periodic preliminary processing of available data.

Full flight GDBs were separated into survey lines and gradually concatenated into the field line database, for a total of 740 lines at the end of acquisition. This updated line GDB allowed for more advanced QC processing (such as effectiveness of lag and diurnal corrections), optimization of flight planning, and periodic deliveries of preliminary field data to **NGU**.

5.3. Positioning Data

The NovAtel ProPak-V3 GPS unit transmitted real-time RT-DGPS data to the RMS Instruments DAARC500 acquisition system for data recording and synchronization, as well as to the Ag-Nav Linav navigation system for line and drape navigation. The ProPak-V3 used Omnistar broadcast data for real-time differential corrections. The synchronization of GPS data with respect to geophysical data consists in the proper alignment of serial RT-DGPS data with respect to a PPS pulse transmitted by the ProPak-V3 specifying the corresponding RMS system time of these data at a precision of 0.015 sec. Synchronization was verified through an analysis of the differences between available clocks (RMS system, Ag-Nav, and ProPak-V3) and of the lag between GPS, barometric, and radar altitudes, in order to detect and correct possible improper alignment caused by occasional spurious serial transmission delays. Gridding and intersection levelling of TMF data provided a final validation of synchronization and instrumental lags.

Recorded airborne raw GPS data were used for DGPS post-processing, using the NovAtel Waypoint software. Waypoint PP-DGPS computations were made either in differential mode, using raw data of the GPS base station, or in precise point positioning (PPP) mode, using CSRS precise clocks and ephemeris data available at the Natural Resource Canada web site. Base station positioning was performed in PPP mode. Mean sea level (MSL) elevations were referenced to the EGM-96-World ellipsoidal-to-orthometric model. Daily and final PP-DGPS quality control, based on the analysis of velocity profiles and on comparison of PP-DGPS, RT-DGPS, and barometric altitudes, ascertained that RT-DGPS precision remained suitable for navigation (< 5 m) and that Waypoint post-processing improved positioning precision to the order of 1m.

PPP-DGPS final data were used to finalize QC of flight path and drape following (channel *drape*) during field operations, to complete radar QC and edits through computation of a digital terrain model (DTM), and to compute altitude differences at intersections, allowing for a precise flagging of line segments displaying excessive deviations and requiring re-flight.

5.4. Altimetry Data and Digital Terrain Model

It is good to first note that the height difference of the GPS antenna with respect to the instrumental platform, which was +2.5 m for C-GFON, was taken into account for all computations involving GPS, barometric, radar, and digital terrain model (DTM) elevations. As an example, the formula used to determine the final DTM elevation is ($DTMf = z – 2.5 – raltlf$).

Raw radar altitude (*raltl*) is first obtained by a linear transformation from raw readings, using parameters determined via the acquisition of an altimeter calibration flight (refer to Section 4.4). Edition of radar data (*raltlc*) is performed via LP filtering against discrete spikes and noise, and by levelling of the resulting DTM elevation, where DTM errors are considered as radar corrections.

The method used for DTM levelling was dictated by the mostly very rugged terrain (0-2395m, prevalence of steep-sided fjords) and its impact on acquired radar data. Saturation of the radar unit occurred over 26.7% of the area where altitudes above ground level (AGL) were in excess of its 730m maximal range. Excessively spiky data were observed over an additional 9.7% of the area above poor reflectors such as cliff edges, for a total of 36.4% of unavailable or unusable data, which then require replacement with data derived from the published DTM supplied by **NGU** (*topoSRTM*, *raltSRTM*) in order to obtain seamless final radar and DTM channels (*raltlf*, *DTMf*). Water surfaces were observed over 7.8% of the area at often marginally high altitudes, causing drifty level-jumps of varying amplitude due to reflectance discontinuity at shores and increasing impact of platform-swing with higher altitudes. Noisier data were observed over 8.0% of the area, in a 4-10 sec transition area surrounding saturated and over-water sections, mostly composed of poorly-reflecting very steep terrain overflow at marginally high altitude. Finally, radar data of good quality were observed over the remaining over-land 47.8% of the area, acquired at lower AGL altitudes and over smoother terrain, with mostly small long-wavelength differences with respect to the AGL altitude of the published DTM.

A low-pass modelization of the difference between acquired and published topography was therefore selected as the most appropriate DTM levelling method, which would result in a proper correlation with the *topoSRTM* data to be substituted in saturated areas. It was then necessary to proceed with a thorough verification of the 80x80m *topoSRTM* grid, which revealed artefacts detrimental to DTM modelization and requiring edition, as follows:

- a series of five 200m wide trenches between (400000E,6750000N) and (400000E,6800000N), a single 200m wide trench between (374500E,6838000N) and

(374500E,6842500N), removed by nulling grid cells and subsequent interpolation via re-gridding,
- a 2m level-shift of sea surface in a 800x2000m area at (347100E,6689000N), reset to 0.0m,
- small level-shifts over the surface of a +53m lake at (359200E,6869500N), reset to +53m,
- reset of slightly negative grid cells to 0.0m (an artefact probably brought by **EON** re-gridding).

The *topoSRTM* channel could then be updated by sampling the edited grid. Finally, the channel *raltSRTM* was computed, which represents the AGL height difference between the radar antenna (*z*-2.5) and the edited *topoSRTM* surface, to be used in saturated areas.

The application of LP filtering used for modelization of the difference between acquired DTM and *topoSRTM* was designed according to the four acquisition situations described above, using as long a wavelength as possible, as required to achieve adequate levelling while minimizing alteration of acquired radar data, as follows:

- flagging of saturated, over-water, transition, and over-land segments,
- median and LP filtering of equivalent 30-40 sec wavelength applied on over-land data,
- LP filtering of 5 sec wavelength applied on merged transition and edited over-land data,
- LP filtering of 1 sec wavelength applied on over-water data, merger with above edited data,
- application of the resulting radar drift correction on *raltl*, application of non-linear de-spiking and LP 0.6 sec noise-removal filtering, and finally nulling (dummy) in the saturation segments to obtain the edited radar channel *raltlc*.

It is good to stress that while the edited radar channel *raltlc* was nulled for the 36.4% of saturated data, the raw channel *raltl* includes saturated readings. The final radar channel *raltlf* consists in the merger of channel *raltlc* and of channel *raltSRTM* in the saturated areas, resulting in a seamless AGL altitude channel. The final digital terrain model *DTMf* could then be computed (*z*-2.5-*raltlf*) and put at the 1Hz sampling rate of GPS data.

As a result of the edition process, the difference between non-saturated *DTMf* and *topoSRTM* passed from +1.7m ±15.7m to +0.2 ±8.2m, while the misties of non-saturated *DTMf* at traverse/tie intersections passed from -0.7m ±9.8m to +0.0m ±6.0m, 98.4% of which being below allowed ±4% of AGL elevation (twice the nominal ±2% precision of the radar unit). These statistics are satisfactory considering the prevailing steepness of the terrain, but serve mostly to establish the general reliability **NGU**'s *raltSRTM* and *topoSRTM* channels. We therefore recommend to use these channels for interpretation purposes, rather than the *raltlf* and *DTMf* channels, the precision of which is hard to evaluate at the low resolution of the line network, that does not allow for more advanced quality control such as micro-levelling.

Raw barometric altitude (*baltl*) is computed from recorded pressure and temperature channels. Edited barometric data (*baltlc*) are obtained by application of non-linear de-spiking and LP 6.0 sec filtering. The difference between barometric and GPS altitudes could then be used to control proper synchronization of GPS, as well as the respective quality of real-time and post-processed GPS elevation data (refer to Section 5.3). Finally, the final barometric altitude *baltlf* was obtained by applying a correction based on a modelization of the difference between *baltlc* and GPS altitude *z*, using spatial LP filtering of 3000m (35 sec).

5.5. Ground-Based Magnetic Data

Two (2) base stations were installed in the Flesla area, the main baseA used for computation of the diurnal correction, and the backup baseB which was located at some distance from baseA in order to assist in the detection of transient cultural signal. Base station profiles were verified daily to ensure that no data were collected during extended of diurnal variations above specified limits, or during periods of excessive micro-pulsations.

As mentioned in Section 4.3, it proved impossible to locate a completely quiet site, as a background high-frequency noise was observed at all attempted sites in the general Bergen area, and the occasional passage of farming vehicles was unavoidable. Also, four different baseA sites had to be used, with two location changes brought by the 2013 destruction of the 1st installation by a herd of sheep, and a third one made at the 2014 re-mobilization.

BaseA data were first edited against cultural signal, mostly confirmable by comparison with baseB data, and consisting of spikes, level-shifts, and/or drifts caused by moving objects. BaseB data had to be substituted in the few cases of missing or excessively cultured baseA data. A standard LP 6 sec filter was then applied to the de-cultured baseA channel in order to partially remove HF noise without filtering out valid diurnal or micro-pulsation signal, and thus alter long-chord QC.

Once all field data were available, baseA data were used to compute and apply a preliminary diurnal correction using respective installation averages (refer to Section 5.6.3). Inspection of the resulting *mreslcb* intersection misties revealed a series of level shifts corresponding exactly with the 3 location changes, then probably caused by a variation in cultural content from site to site. Level corrections were therefore applied from baseA to the final raw and edited channels *baseCo* and *baseC*, in order to obtain a constant average of 50920.570nT, as follows:

- flights 001-023: +00nT,
- flights 024-025: -28nT,
- flights 026-054: +21nT,
- flights 058-119: +33nT.

5.6. Airborne Magnetic Data

The processing flow of airborne total magnetic field (TMF) data was designed around the application of a Taylor correction against signals generated by deviation from the planned altitude above ground level (AGL) of the drape surface. The methodology of intersection levelling is well-designed for the removal of superimposed long-wavelength diurnal signal. It is however less efficient against the often short-wavelength signal resulting from AGL deviations, especially if the spatial resolution of the levelling network is low and if high-amplitude AGL signal is frequently generated in high-gradient area. In view of the 1000m x 10000m resolution of the present survey, and since an estimated 10-15% of intersection were altered by AGL signal, it was deemed necessary to apply a Taylor correction, which however does cause some disruptions of the processing flow since:

- its computation requires optimal vertical gradient grids, themselves requiring pre-application of culture edition, IGRF, and diurnal removal, as well as a preliminary near-final levelling,
- it is preferable to perform noise edition of TMF data after application of the Taylor correction, since higher-frequency AGL signal is often indistinguishable from, and often associated with, residual compensation noise.

5.6.1. Compensation and 1st Phase of Edition against Transient Cultural Signal

The removal of magnetic signals related to the heading and manoeuvring of the aircraft was applied by the RMS Instruments DAARC500 real-time compensator, based on a compensation solution acquired and validated during an FOM test flight (refer to Appendix B). Real-time compensation allows for in-flight quality control, as the operator may determine when turbulence level becomes detrimental to data quality and abort the acquisition when advisable. Following the application of the lag correction, uncompensated (*um3l*) and compensated (*m3l*) raw TMF profiles were monitored on a daily basis to further assess compensation effectiveness.

The edited TMF channel (*maglc*) is obtained via two distinct correction phases:

1) removal of discrete transient cultural signals (the object of this section), performed on a daily basis whenever possible, and completed prior to the computation of the Taylor correction,

2) removal of residual compensation noise from de-cultured *maglc*, to be performed after application of the Taylor correction as stated above (refer to Section 5.6.7).

Transient cultural signals originate either from the operation of the aircraft or from external sources such as radar towers, and are observable, on both uncompensated and compensated channels, as spikes, level-shifts, and/or bursts of high-frequency noise of varying length and amplitudes. Their manual removal is mostly straight-forward and consists in adjustment of constant level-shifts, minimum curvature re-interpolation over short intervals, and/or local filtering. The main difficulty resides in their detection, especially in high-gradient TMF, and requires a meticulous inspection of a battery of QC channels, including 4th difference, noise channels of 1.5 to 5.0 seconds wavelengths, as well as high-pass versions of the *um3l*, *m3l*, and preliminarily edited *maglc* channels (refer to Section 5.6.7). Sources of discrete noise included:

- radio transmissions from the aircraft, unavoidable in an inhabited and developed area comprising several airports and significant conflicting traffic, by far the most frequent transient source, and observable as negative spikes or level-shifts of amplitude ranging from 0.05 to 5.0nT,
- most other avionics operations (fuel pumping, de-icing, ON/OF switching of heaters, etc.) could mostly be performed during the turns, but occasionally occurred on-line, such as the 0.55nT square-wave pattern of flight 044, or a level-shift of 16nT on L5790,
- occasional sustained bursts of high-frequency noise, similar to the noise observed on the magnetic base stations (refer to Section 5.5), probably from an external source,
- a radar tower occasionally generating spikes and irregular level-shifts, mostly negative, of amplitude up to 3.8nT (west end of L1820-1880, flight 005).

5.6.2. Partial IGRF Correction from Flight to Drape Surfaces

The first of two (2) altitude corrections, performed in order to alleviate the impact on TMF of erratic deviations from the planned drape surface between adjacent traverses, consisted in the computation of a partial IGRF correction from flight to drape surfaces. Removal of the IGRF signal generated by deviation from drape was performed as follows:

- computation of the IGRF field on the flight surface (*z*), using the 2010 model,
- computation of the IGRF field on the drape surface (*drape*), using the 2010 model,
- computation of the final IGRF signal to remove: (flight surface IGRF- drape surface IGRF) re-interpolated (minimum curvature) at 10Hz and low-pass filtered (3 sec),
- subtraction of the IGRF signal from the preliminarily edited TMF (*mreslc* = *maglc* - IGRF signal).

5.6.3. Diurnal Correction

The diurnal signal to remove from the preliminarily altitude-corrected TMF (*mreslc*) was obtained by the application of low-pass spatial filtering on the edited TMF obtained at the main base station (*baseC*, refer to Section 5.5). A filter wavelength of 20000m was selected 1) for its effectiveness at eradicating all possibly cultural *baseC* signal, 2) for its adequate optimization of intersection mistie statistics, 3) for an adequate decorrugation of diurnal-corrected TMF grids, and 4) since this length is equal to the resolution of the levelling network on traverses, meaning that any TMF signal possibly added by the correction remains removable by levelling. Removal of the diurnal signal was performed as follows:

- computation of the final diurnal signal to remove: (*baseC* - average 50920.570nT) re-interpolated (minimum curvature) at 10Hz and low-pass filtered at a length of 20000m,
- subtraction of the diurnal signal from the preliminarily edited and altitude-corrected TMF (*mreslcb* = *mreslc* - diurnal signal).

5.6.4. 1st Phase of Intersection Levelling

As mentioned above, levelling of the corrected TMF (*mreslcb* to *mreslvl*) was performed in two phases:

- 1st phase: initial levelling of the preliminarily corrected TMF, aimed solely at the eradication of most residual diurnal signal, in order to obtain decorrugated and near-final grids of the vertical derivatives of TMF as a preparation for the following stages of final line selection (Section 5.6.5), Taylor altitude correction (Section 5.6.6), and the 2nd phase of TMF edition (Section 5.6.7),
- 2nd phase: final levelling of fully corrected TMF (Section 5.6.8).

The method of iterative intersection levelling aims at the proper statistical re-distribution of TMF differences at tie-traverse intersections (misties). It was planned according to eight (8) iterative passes, with parameters designed to fit the present line spacing geometry, as described in Table 1 below. Each pass, applied first on ties, then on traverses, modelizes the updated *mreslvl* misties left by the previous correction by using LP filter models of gradually decreasing wavelengths. This ensures a progressive reduction of misties eventually resulting in the smoothest possible levelling corrections with minimal line-to-line correlation (often referred to as "tie-pull"). Results of each iterative modelization are further optimized by the proper re-selection of the misties that are actually used in computation, by removing aberrant misties that excessively influence the current model. Typically, as little as 85-90% of misties are selected at the initial passes, since several of the intersecting lines are not yet properly modelized. The selection rate gradually increases as levelling progresses to shorter wavelengths, eventually leading to a selection rate of 98% or better at the final pass.

Phase	Ties	Correction filter model	Traverses	Correction filter model
1st phase	Pass 1a	polynomial degree 0	Pass 1b	polynomial degree 0
	Pass 2a	spatial 400000 m	Pass 2b	spatial 400000 m
	Pass 3a	spatial 200000 m	Pass 3b	spatial 200000 m
	Pass 4a	spatial 100000 m	Pass 4b	spatial 100000 m
	Pass 5a	spatial 48000 m	Pass 5b	spatial 60000 m
2nd phase	Pass 6a	spatial 20000 m	Pass 6b	spatial 40000 m
	Pass 7a	spatial 10000 m	Pass 7b	spatial 30000 m
	Pass 8a	spatial 3000-4000 m	Pass 8b	spline interpolation

Table 1: Parameters of Iterative Intersection Levelling of TMF

As mentioned, the present 1st levelling phase, limited to the execution of passes 1-5, aimed at the near-total removal of corrugations related to diurnal activity from grids of the vertical derivative of TMF. It was then imperative that correction models of pass 5 display a maximal amplitude and wavelength correlation with recorded diurnal activity, and, conversely, a minimal correlation with drape deviation. For this purpose, all sharper misties corresponding to larger drape deviations in higher gradient areas were systematically deselected. Corrections models were either 1) advanced up to pass 7 whenever mistie patterns were observed to have amplitude and wavelength content similar to diurnal activity, or 2) retarded down to flat polynomial models when diurnals were calm.

At the end of pass 5, 95.2% of misties were selected, and TMF grids of required quality could be obtained. The 4.8% of misties still deselected, as well as an additional 5-10% of selected misties, would require high-frequency and high-amplitude correction models unjustified by local levels of diurnal activity and correlated with drape deviation and local magnetic gradients. The next processing steps were line selection (Section 5.6.5), in order to remove part of the de-selected misties as most reflights were aimed at larger and more sustained drape deviations, and Taylor correction (Section 5.6.6) to improve most of the remaining sharp misties.

5.6.5. Final Line Selection

The previous processing steps were performed on all acquired survey lines, including re-flights and overlap of the numerous lines flown in multiple segments, amounting to a total of 740 lines and 79,977 km. The final kilometreage to be kept in the final database is determined by the proper selection among overlapping full survey lines and/or trimming of line segments so as to obtain a minimal overlap of 100-200m over an intersecting line. In order to preserve data of the best overall quality, selection and trimming criteria were, in order of priority:

1) minimal drape deviation and/or altitude difference at intersections,
2) minimal pass 5 *mreslvl* misties,
3) minimal diurnal activity,
4) minimal flight path deviation,
5) minimal level of TMF noise.

Selected line and/or line segments were exported to the final survey database, amounting to a total of 730 survey lines and 75,115 km, with 4,862 km removed (6.1% of acquired kilometers). The 1st phase of levelling was then updated to adjust to the new line content, with an improved selection of 95.8% of the misties resulting from the removal of the most detrimental altitude deviations.

5.6.6. Taylor Correction from Flight to Drape Surfaces

The Taylor expansion is used to alleviate the effect of erratic AGL altitude deviations between adjacent traverses as well as between intersecting ties and traverses. This 2nd altitude correction was implemented according to the general Geological Survey of Canada (GSC) recommendations of 1) limiting the correction distance to the deviation from the AGL altitude of the planned drape surface, rather than to the greater deviation from the nominal AGL altitude of the survey, and 2) using only the first degree term (1st vertical derivative) of the theoretical Taylor expansion as higher degree terms gets exponentially noisier and detrimental. As the Taylor correction is of strong amplitude and high frequency, its use must be justified by a significant improvement of TMF misties and a general improvement of TMF profiles (refer to Section 5.6.7).

The magnetic signal generated by deviation from the target AGL altitude of the drape surface, to remove from the IGRF-corrected TMF *mreslc* channel (Section 5.6.2) in order to obtain the fully altitude-corrected TMF *mreslct* channel, was computed as follows:

- computation of a 1st vertical derivative grid of TMF (VG1), using all available corrections (culture edition, partial IGRF removal, diurnal removal and pass 5 levelling), using traverse lines only, at a cell size of 50m, and using 10Hz versions of (*x*, *y*) channels,
- sampling of the VG1 grid into a database channel, edition based on the Oasis 1DFFT version of VG1 for the tie lines sections acquired above traverse gaps resulting from national security requirements,
- computation of a 10Hz version of drape deviation (*z* - 2.5m - *drape*),
- computation of the AGL signal to remove: (-DrapeDev * VG1) low-pass filtered (2 sec),
- subtraction of the AGL signal and update of TMF channels: (*mreslct* = *mreslc* - AGL signal), (*mreslcb* = *mreslct* - diurnal signal), (*mreslvl* = *mreslcb* + levelling correction).

The 1st phase of levelling was again updated to adjust to the effect of the Taylor correction, using the same levelling models as those used in the 1st phase (Section 5.6.4). Mistie selection was improved to 97.7%, with an additional improvement over 10% of the updated misties to amplitude and wavelength patterns more closely correlating with local levels of diurnal activity.

5.6.7. 2nd Phase of Edition against TMF Noise

This 2nd phase of TMF edition (*m3l* to *maglc*) consists in the detection and removal of the residual TMF high-frequency noise still remaining after real-time compensation, caused by acquisition in frequently turbulent and windy conditions. It is good to note that although this correction will be added to the culture correction (Section 5.6.1) to obtain the final version of the edited TMF *maglc* channel, actual computations to determine the noise to remove were made from the Taylor corrected *mreslvl* channel, for the reasons stated in the introduction to Section 5.6.

In order to achieve adequate noise removal while avoiding distortion of the smaller geological anomalies, a combination of low-pass and high-pass filtering was used to construct five (5) TMF noise channels of wavelengths equivalent to 1.5sec, 2.0sec, 3.0sec, 4.0sec, and 5.0sec, generally un-responsive to most anomalies. In order to improve noise detection in higher gradient, high-pass versions of the uncompensated *um3l*, compensated *m3l*, culture-edited *maglc*, and Taylor-corrected *mreslvl* were also created, using the standard 12 sec wavelength of FOM test compilation. The 2.0 sec noise channel was initially removed from all preliminarily processed channels (*maglc* to *mreslvl*). Followed a meticulous evaluation of the effectiveness of the achieved noise removal over the whole TMF and QC channel series, resulting in the local substitution with the stronger 3.0-5.0 sec noise channels as allowed by local signal-to-noise ratio, or, for sections of more active TMF, use of the 1.5 sec noise channel or zero-filtering. An evaluation of the effect of the Taylor correction was also made during above profile inspection and it could be ascertained that it resulted in a general improvement and smoothening of TMF profiles.

Statistics of total TMF edition (culture and residual compensation noise removal) are well within the allowed noise envelope, especially considering the unusual amounts of cultural noise:

- 97.49% <= ±0.10nT,
- 99.03% <= ±0.20nT,
- 99.55% <= ±0.50nT.

5.6.8. 2nd Phase of Intersection Levelling

With all TMF corrections applied, most especially the Taylor correction (Section 5.6.6), the 2nd phase of intersection levelling could be finalized as planned (passes 6-8, Section 5.6.4). At pass 8, final LP spatial models used for ties were of length 3000m or 4000m, according to the level of diurnal activity and/or drape deviation, and, for traverses, spline interpolation of selected misties.

In order to assist in final levelling as a QC tool, as well as to evaluate the pertinence of its utilization, a micro-levelling correction was updated after each remaining passes, as follows:

- computation of a grid of updated *mreslvl*, using traverses only, use of directional 2-D spatial filtering (3000m, N225°) to obtain a raw micro-levelled grid,
- computation of a raw micro-levelling correction channel from the above micro-levelled grid,
- clipping of the raw micro-levelling correction to ±8nT, based on statistics of remaining misties, and application of a 4000m low-pass spatial filter in order to obtain the micro-levelling correction.

This micro-levelling correction channel was especially useful in the determination of the selection status of the very few sharper misties remaining in areas of excess drape deviation where safety avoidances had been required, and the Taylor correction proved less effective. Whenever a good correlation was observed between micro-levelling amplitude, mistie amplitude and the occurrence of larger drape deviation, some sharper misties could be re-selected and modelized without detrimental effect on the final grid products.

Final intersection selection was of 99.4%, where near-zero misties were achieved, the remaining 0.6% being mostly located above very sharp anomalies, often cultural, and/or in areas of safety avoidances.

Inspection of the resulting *mreslvl* grids revealed a few areas still displaying small corrugation patterns, all located within the 10 km intervals between tie-lines, where interpolated levelling models are more likely to be less effective. Such residual diurnal corrugations resulted either from the low resolution of 10 km levelling network, or from over-shoots of the spline model for a few lines that required stronger levelling corrections, and all displayed an excellent correlation with the micro-levelling correction channel. However, the TMF grids also displayed a network of anomalies with a NW-SE trend parallel to traverse lines, of strong amplitude in high-gradient areas and of low amplitude in low-gradient areas. Since most low-gradient areas correlated with higher drape altitudes, it was very likely that these anomalies could correspond to deeper geological structures that are attenuated at higher acquisition altitude. Therefore, a systematic application of micro-levelling would result in 1) the valid correction of very small diurnal corrugations in low-gradient areas, and 2) an unacceptable over-smoothing of deeper structures already attenuated by flight altitude.

An adequate solution to this problem was achieved by proceeding to a limited manual application of the micro-levelling correction, strictly targeting residual corrugations located in the intervals between tie-lines and displaying a strong correlation with diurnal activity. It was implemented by the generation of 503 pseudo-intersection points, which were assigned a correction value determined from the local amplitude the micro-levelling correction, and integrated with the real intersection points in order to locally optimize the levelling correction.

5.6.9. IGRF Residual of TMF

Finally, the IGRF residual of the leveled TMF (*mreslvli*) was computed as follows:

- computation of the IGRF field using the 2010 model, a fixed date of 2014/02/01, and a fixed acquisition altitude of 1308m,
- subtraction of the IGRF field from leveled TMF (*mreslvli* = *mreslvl* - IGRF).

5.6.10. Gridded Data

The following grids were delivered with the final Oasis GDB database described in Appendix C. They were computed according to a GSC method designed to very significantly alleviate the aspect of grids of vertical derivatives obtained directly from Oasis magmap1 GX, which are typically very noisy and filled with artefacts between survey lines. Additional processing consisted in two (2) phases of masking, first outside of the contractual survey boundary, and second inside areas where traverse coverage was prohibited by national security authorities.

• Leveled TMF	channel *mreslvl*	mreslvl_tmf.grd,
• IGRF residual of leveled TMF	channel *mreslvli*	mreslvl_igrf.grd,
• 1st vertical derivative of leveled TMF	channel *mreslvl_vg1*	mreslvl_vg1.grd,
• 2nd vertical derivative of leveled TMF	channel *mreslvl_vg2*	mreslvl_vg2.grd.

The gridding method was as follows:

- gridding of *mreslvl* and *mreslvli* channels using traverse lines only,
- preliminary computation of VG1 and VG2 grids with the magmap1 GX,
- sampling of the derivative grids into database channels (*mreslvl_vg1*, *mreslvl_vg2*), again for traverse lines only,
- re-gridding of *mreslvl_vg1* and *mreslvl_vg2* with a high number of iterations,
- application of masking (survey boundary, prohibited survey).

6. Final Deliverables

6.1. Digital Data

The following digital data were delivered to **NGU** in two (2) DVD copies:

Final Digital Data		
Product	**Data**	**Format and projection**
Database	Magnetic survey data	Geosoft GDB, WGS-84
Grids	Total magnetic field	Geosoft GRD, WGS-84
	Residual magnetic field	Geosoft GRD, WGS-84
	First vertical derivative of the total magnetic field	Geosoft GRD, WGS-84
	Second vertical derivative of the total magnetic field	Geosoft GRD, WGS-84
	Digital terrain model	Geosoft GRD, WGS-84
Report	Logistics, processing, and documentation of products	WORD and PDF

A description of the fields delivered in the final processed database is given in Appendix C.

6.2. Other Products

- Two (2) paper copies of the final report

7. Conclusion

Data acquisition was completed using a Piper Cheyenne II PA-31T aircraft, registration C-GFON, with a single magnetometer installed in a tail stinger.

Once at the base of operation, approximately seven (7) months were necessary to acquire the total of 75,115 line-kilometers of data, including tests and calibrations on-site. In the middle of the project, the survey was temporarily halted for about one and a half (1.5) months due to bad weather conditions and shortening daylight.

Major delays were due primarily to bad weather in late fall and during winter.

Re-flights were mostly selected on the basis of deviations from drape due to inclement weather conditions. All final accepted data were of high quality, and final products were delivered as required by **NGU**.

Submitted by: ____________________________

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President
EON Geosciences Inc.

Appendix A – STAS-13 Survey Area Coordinates

Boundaries – Aeromagnetic Survey – STAS-13 – Norway, 2013-2014 (WGS84 Zone 32N)

Corner #	X	Y	Longitude °E	Latitude °N
1	527528.77	7044372.53	9.553479	63.526509
2	542023.57	7029911.30	9.841055	63.395317
3	535149.93	7022888.34	9.701961	63.333035
4	533461.14	7017286.71	9.667074	63.282927
5	538525.93	7012200.51	9.766823	63.236774
6	521521.13	6995189.38	9.426127	63.085523
7	542698.41	6973984.22	9.839921	62.893341
8	537123.39	6968412.47	9.729025	62.843946
9	558334.51	6947146.73	10.138112	62.650340
10	551398.73	6940226.18	10.000727	62.589265
11	551521.02	6936956.88	10.002120	62.559908
12	556879.26	6931595.55	10.104536	62.511009
13	555454.54	6930189.86	10.076420	62.498610
14	562560.23	6923107.09	10.211735	62.433918
15	561833.74	6922385.52	10.197408	62.427565
16	568937.39	6915348.26	10.332121	62.363166
17	567917.06	6914325.10	10.312009	62.354172
18	570454.64	6911186.95	10.359740	62.325540
19	574484.18	6906801.17	10.435602	62.285403
20	567786.43	6900093.01	10.303948	62.226478
21	562703.64	6905173.08	10.208025	62.272952
22	559391.39	6905811.56	10.144445	62.279223
23	528904.48	6875274.61	9.552014	62.008721
24	523812.19	6880401.46	9.455454	62.055095
25	515308.24	6875630.31	9.292391	62.012708
26	501500.20	6889455.72	9.028772	62.137118
27	501352.54	6889295.77	9.025938	62.135683
28	500957.77	6889690.55	9.018370	62.139228
29	500774.48	6889507.26	9.014854	62.137583
30	501176.30	6889105.43	9.022557	62.133975
31	487422.73	6874398.27	8.759857	62.001749
32	488081.50	6873211.12	8.772515	61.991114
33	493300.78	6867965.23	8.872330	61.944152
34	491844.74	6866502.12	8.844649	61.930990
35	493628.52	6863307.68	8.878742	61.902348
36	498268.41	6858770.89	8.967089	61.861672
37	496912.36	6857427.95	8.941339	61.849608
38	497717.61	6856001.25	8.956656	61.836807
39	494879.15	6855378.88	8.902769	61.831192
40	486479.37	6847023.25	8.743906	61.755981
41	481184.58	6852287.25	8.643072	61.803010
42	476682.95	6851277.30	8.557810	61.793696
43	475457.60	6850049.97	8.534739	61.782602
44	472699.96	6843323.19	8.483477	61.722032
45	477768.30	6838254.85	8.579986	61.676862
46	474877.20	6835399.45	8.525761	61.651052
47	489040.77	6821234.83	8.793967	61.524560
48	485934.10	6818114.23	8.735800	61.496445
49	485278.24	6813557.80	8.723844	61.455517
50	490477.91	6808536.55	8.821638	61.410603
51	483631.14	6801684.05	8.693992	61.348857
52	483045.53	6797495.96	8.683424	61.311235
53	488282.16	6792257.73	8.781529	61.264401
54	422014.02	6725922.32	7.573191	60.661420
55	411660.76	6711876.01	7.390143	60.533205
56	416895.47	6706656.27	7.487683	60.487471
57	382918.97	6672764.05	6.889543	60.174930
58	372757.17	6658950.99	6.715139	60.047959
59	378043.78	6653676.54	6.813117	60.002239
60	353253.75	6628879.59	6.386621	59.771707
61	351720.60	6623365.32	6.363253	59.721699
62	356752.18	6618337.94	6.456047	59.678364
63	347752.78	6609292.68	6.302946	59.594036
64	346130.15	6603463.72	6.278466	59.541158
65	351064.57	6598513.15	6.369097	59.498534
66	342260.74	6589663.20	6.220315	59.415936
67	340879.86	6584725.90	6.199672	59.371131
68	346117.77	6579440.65	6.295507	59.325667

Boundaries – Aeromagnetic Survey – STAS-13 – Norway, 2013-2014 (WGS84 Zone 32N)				
Corner #	**X**	**Y**	**Longitude °E**	**Latitude °N**
69	336786.19	6570064.02	6.138805	59.238064
70	336591.29	6569417.73	6.135879	59.232192
71	322706.13	6552531.93	5.906615	59.075192
72	299271.96	6575867.56	5.477100	59.273978
73	303730.91	6580366.08	5.551109	59.316394
74	303865.99	6584213.53	5.549979	59.350945
75	298713.58	6589358.81	5.454732	59.394636
76	304221.88	6594894.25	5.546488	59.446851
77	304351.52	6599113.27	5.544908	59.484729
78	299365.26	6604155.73	5.452299	59.527569
79	304739.00	6609560.43	5.542148	59.578554
80	304739.00	6610127.42	5.541626	59.583636
81	297928.37	6616908.51	5.414792	59.641173
82	299741.82	6618721.73	5.445173	59.658299
83	300557.78	6624163.99	5.454470	59.707466
84	295831.45	6628896.12	5.366039	59.747581
85	298047.28	6631132.32	5.403231	59.768705
86	297820.35	6631334.03	5.399004	59.770402
87	296943.36	6633499.19	5.381318	59.789377
88	291575.97	6638914.21	5.280487	59.835236
89	294005.83	6641236.47	5.321447	59.857262
90	292642.56	6644780.22	5.293625	59.888335
91	288008.19	6649444.45	5.206226	59.927773
92	293475.54	6654897.93	5.298376	59.979414
93	294768.18	6659642.10	5.316760	60.022572
94	289437.49	6665061.12	5.215772	60.068427
95	298215.95	6673768.39	5.364561	60.150868
96	297055.15	6677166.49	5.340308	60.180743
97	291652.45	6682543.22	5.237604	60.226194
98	297623.56	6688514.74	5.339196	60.282713
99	298249.29	6691588.47	5.347412	60.310566
100	292698.07	6697148.23	5.241428	60.357583
101	295938.87	6700389.03	5.296744	60.388265
102	295692.31	6701194.19	5.291459	60.395355
103	289390.10	6707380.11	5.170838	60.447542
104	292510.53	6710488.20	5.224190	60.477003
105	291579.14	6713382.22	5.204252	60.502450
106	303259.89	6724692.28	5.405234	60.609673
107	297905.40	6730048.20	5.302136	60.654999
108	302098.78	6734241.58	5.374454	60.694668
109	299449.85	6738348.35	5.321834	60.730143
110	295788.34	6742093.49	5.250931	60.761840
111	281632.39	6756194.90	4.975916	60.880632
112	284431.66	6758994.17	5.024231	60.907234
113	283913.29	6762537.03	5.010726	60.938683
114	278872.72	6767522.58	4.912211	60.980545
115	282586.52	6771217.33	4.976475	61.015696
116	282166.12	6774037.24	4.965507	61.040718
117	276362.71	6779857.61	4.851527	61.089585
118	281784.15	6785279.05	4.945572	61.141181
119	281903.18	6788291.47	4.944311	61.168224
120	276793.13	6793666.69	4.843231	61.213479
121	282282.59	6799220.77	4.938735	61.266309
122	282441.44	6803392.13	4.936857	61.303751
123	277405.59	6808484.23	4.837042	61.346503
124	282772.48	6813892.61	4.930814	61.397966
125	282949.36	6818565.43	4.928663	61.439909
126	278167.18	6823408.06	4.833442	61.480562
127	287969.15	6833227.73	5.005719	61.573995
128	280987.55	6840371.08	4.866066	61.634053
129	285597.53	6844974.24	4.947420	61.677870
130	285999.37	6849526.32	4.949644	61.718856
131	281001.53	6854465.58	4.849384	61.760256
132	288567.00	6862086.73	4.983434	61.832759
133	290344.77	6867750.67	5.010511	61.884461
134	285241.51	6872858.79	4.907575	61.927353
135	295085.87	6882693.49	5.083343	62.020867
136	296858.04	6888211.00	5.110807	62.071237
137	291618.94	6893386.20	5.004691	62.114725
138	298800.16	6900579.13	5.133781	62.183047
139	298935.76	6900441.52	5.136537	62.181887

Boundaries – Aeromagnetic Survey – STAS-13 – Norway, 2013-2014 (WGS84 Zone 32N)

Corner #	X	Y	Longitude °E	Latitude °N
140	299151.63	6900662.38	5.140421	62.183980
141	299012.89	6900810.36	5.137593	62.185231
142	328832.18	6930604.96	5.680047	62.466996
143	334028.42	6925427.12	5.785631	62.422952
144	341108.34	6928808.91	5.919388	62.456355
145	357064.67	6944716.97	6.215000	62.605459
146	358455.87	6945978.60	6.241018	62.617306
147	358767.45	6946601.76	6.246565	62.623012
148	359130.93	6946799.07	6.253478	62.624920
149	374731.90	6962411.42	6.545717	62.770553
150	379880.35	6957260.06	6.650162	62.726078
151	387390.29	6961059.68	6.794398	62.762537
152	396912.49	6970517.12	6.974936	62.850171
153	402899.47	6980016.86	7.086919	62.937028
154	397646.72	6985277.22	6.980251	62.982773
155	405167.48	6992813.50	7.124223	63.052418
156	410252.98	6987728.90	7.227526	63.008101
157	414421.62	6987869.16	7.309739	63.010366
158	433393.99	7006969.69	7.676557	63.185731
159	438605.70	7001788.94	7.782035	63.140171
160	448774.68	7008133.52	7.981734	63.198692
161	468835.97	7028122.08	8.376617	63.380374
162	473993.93	7022989.29	8.480619	63.334723
163	480216.98	7025439.78	8.604597	63.357114
164	492142.71	7037357.97	8.842368	63.464537
165	497346.85	7032202.42	8.946859	63.418345
166	503335.20	7034533.21	9.066851	63.439257
167	515475.85	7046578.43	9.311371	63.547036
168	520695.94	7041349.56	9.415712	63.499844
169	526894.79	7043811.09	9.540638	63.521519

Appendix B – Calibration Tests Results

B.1. Figure of Merit (FOM)

EON Geosciences Inc.

FOM Test:	**MAG3: tail stinger**	Date:	September 22nd 2013
Slot:	mat5.x	Flight:	801
Project:	13003	Location:	Bergen Area
Client:	NGU	Aircraft:	C-GFON
Pilot:	Alain Charon	Sensors:	1 tail stinger
Operator	AP Camitsis	Altitude:	3088m
Processor:	Rick Bailey	Comp:	RMS DAARC 500

Notes: **12 seconds** high pass filter used to determine amplitudes.

MAG 3 Results	**ucomp**	**comp**	**IR**
Total	**6.680**	**0.524**	**12.748**

NW (N315)	Line	Fid range start	end	ucomp	comp	IR
Pitch	99315	53417	53432	0.622	0.033	18.848
Roll		53432	53449	0.959	0.031	30.935
Yaw		53450	53461	0.383	0.034	11.265
Total				**1.964**	**0.098**	**20.041**

NE (N045)	Line	Fid range start	end	ucomp	comp	IR
Pitch	99045	53506	53519	0.687	0.045	15.267
Roll		53520	53533	0.398	0.025	15.920
Yaw		53537	53553	0.245	0.013	18.846
Total				**1.330**	**0.083**	**16.024**

SE (S135)	Line	Fid range start	end	ucomp	comp	IR
Pitch	99135	53630	53644	0.415	0.067	6.194
Roll		53646	53660	0.815	0.043	18.953
Yaw		53660	53677	0.320	0.040	8.000
Total				**1.550**	**0.150**	**10.333**

SW (N225)	Line	Fid range start	end	ucomp	comp	IR
Pitch	99225	53736	53752	0.429	0.086	4.988
Roll		53753	53769	1.311	0.027	48.556
Yaw		53768	53784	0.096	0.080	1.200
Total				**1.836**	**0.193**	**9.513**

EON Geosciences Inc.

FOM Test:	**MAG3: tail stinger**	Date:	Jan 31st 2014
Slot:	mat7.x	Flight:	57
Project:	13003	Location:	Bergen Area
Client:	NGU	Aircraft:	C-GFON
Pilot:	Ray Fromm	Sensors:	1 tail stinger
Operator	AP Camitsis	Altitude:	3489m
Processor:	Gerard Tessier	Comp:	RMS DAARC 500

Notes: **12 seconds** high pass filter used to determine amplitudes.

MAG 3 Results	**ucomp**	**comp**	**IR**
Total	**14.326**	**1.112**	**12.883**

NW	Line		Fid range	ucomp	comp	IR
(N310)		start	end			
Pitch	99315	38969	38977	1.291	0.107	12.065
Roll		38978	38985	1.082	0.120	9.017
Yaw		37986	38996	1.608	0.101	15.921
Total				**3.981**	**0.328**	**12.137**

NE	Line		Fid range	ucomp	comp	IR
(N048)		start	end			
Pitch	99045	39074	39081	1.291	0.080	16.138
Roll		39082	39090	1.987	0.085	23.376
Yaw		39091	39098	0.843	0.110	7.664
Total				**4.121**	**0.275**	**14.985**

SE	Line		Fid range	ucomp	comp	IR
(S138)		start	end			
Pitch	99135	39168	39175	1.497	0.091	16.451
Roll		39176	39183	1.152	0.062	18.581
Yaw		39185	39194	0.590	0.071	8.310
Total				**3.239**	**0.224**	**14.460**

SW	Line		Fid range	ucomp	comp	IR
(N229)		start	end			
Pitch	99225	39259	39265	1.095	0.094	11.649
Roll		39266	39273	1.234	0.096	12.854
Yaw		39275	39284	0.656	0.095	6.905
Total				**2.985**	**0.285**	**10.474**

B.2. Altimeter Calibration

C-GFON Sept 12th 2013			Altimeter calibration(Radar A, low-alt, 2 slopes)							Bromont	RunwayH	110.4	mMSL
EON Geosciences Inc.			Aircraft: C-GFON							CZBM	AntH	2.5	m
		Units	mMSL	uV	m	m	mMSL	mbar	C	mMSL	mMSL	mMSL	m
Line	fid range		z	rrawAo	raltAo	*raltAerr*	DTM	PrawBo	TrawBo	bstpBo	brawBo	baltBo	*baltBerr*
90000	50241	50446	112.8	110206	0.0	*0.1*	110.3	994.3	20.9	162.0	162.5	128.2	*15.4*
90100	50719	50737	144.8	768380	32.1	*0.2*	110.2	992.5	20.7	177.5	178.0	143.9	*-0.9*
90200	50918	50938	176.8	1419858	64.0	*0.1*	110.3	988.9	20.1	208.7	208.8	175.3	*-1.5*
90300	51075	51093	211.1	2114512	97.9	*-0.3*	110.7	984.9	19.9	243.5	243.4	210.5	*-0.6*
90400	51261	51281	241.1	2741489	128.6	*0.4*	110.0	981.5	19.7	273.2	272.9	240.4	*-0.7*
90500	51532	51550	272.9	3193499	158.0	*-2.0*	112.4	977.8	19.4	305.6	305.0	273.0	*0.1*
90600	51709	51729	306.8	3300803	192.2	*-1.7*	112.1	973.9	19.1	339.9	338.8	307.5	*0.7*
90700	51874	51893	331.7	3390059	220.7	*1.9*	108.5	971.0	19.0	365.5	364.2	333.3	*1.6*
90800	52065	52085	370.8	3499210	255.5	*-2.4*	112.8	966.6	18.7	404.4	402.7	372.4	*1.6*
90900	52238	52257	394.5	3577653	280.4	*-1.2*	111.6	964.0	18.5	427.6	425.4	395.4	*0.9*
91000	52418	52437	431.3	3702551	320.3	*1.9*	108.5	959.9	18.3	464.1	461.4	432.1	*0.8*
91500	52611	52629	597.5	4257398	497.1	*12.5*	97.9	941.5	16.7	630.2	623.1	596.5	*-1.0*
92000	52800	52818	745.6	4654427	623.6	*-9.1*	119.5	925.1	15.4	781.0	768.7	744.5	*-1.1*
						0.0	**110.4**						***0.0***
						0.0	**110.4**				**baltBo**	a	b
											linest	1.0166008	-36.98
											used	**1.0166008**	**-36.98**

Bromont, CZBM, 374', 114.0m

Used average GPS-Z minus antH, 110.4m

Constants and formulaes below are valid under 11000m

Baro	Constants (sea level)	units
8314.32	**R** - Universal Gas Constant	kmol-1
273.15	**T** - Celsius zero in Kelvin	K
28.96442	**M** - Molecular Weight of Air	kg*kmol-1
9.80665	**g** - acceleration of gravity	m*s-2
0.00	**H** - Datum Height	m
1013.25	**P** - Datum Pressure	mbar
20.00	**st** - Standard Temperature	Celsius

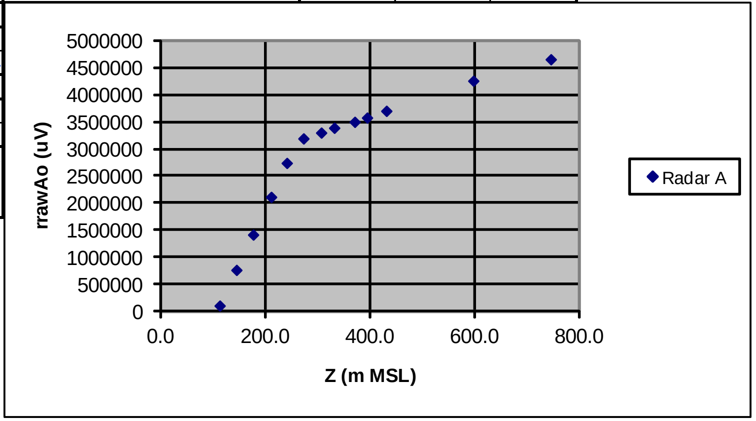
Formula for **MSL** baro altitude from pressure and temperature

brawBo= **H** + (**R***(TrawBo+**T**)/**M*****g**)*ln(**P**/PrawBo)

Formula for **STP** baro altitude from pressure and STP temperature

bstpBo= **H** + (**R***(**st**+**T**)/**M*****g**)*ln(**P**/PrawBo)

L.R. a (low altitude)			
a raw	b raw	**a used**	**b used**
0.0000488625	107.4	**0.0000488625**	**-5.4**
L.R. b (high altitude)			
a raw	b raw	**a used**	**b used**
0.0003186864	-746.8	**0.0003186864**	**-859.7**
L.R. a and b intersect at		rrawAo=	**3166138.5**
		raltAo=	149.3
		raltAo=	149.3



Appendix C – Final Processed Database Field Description

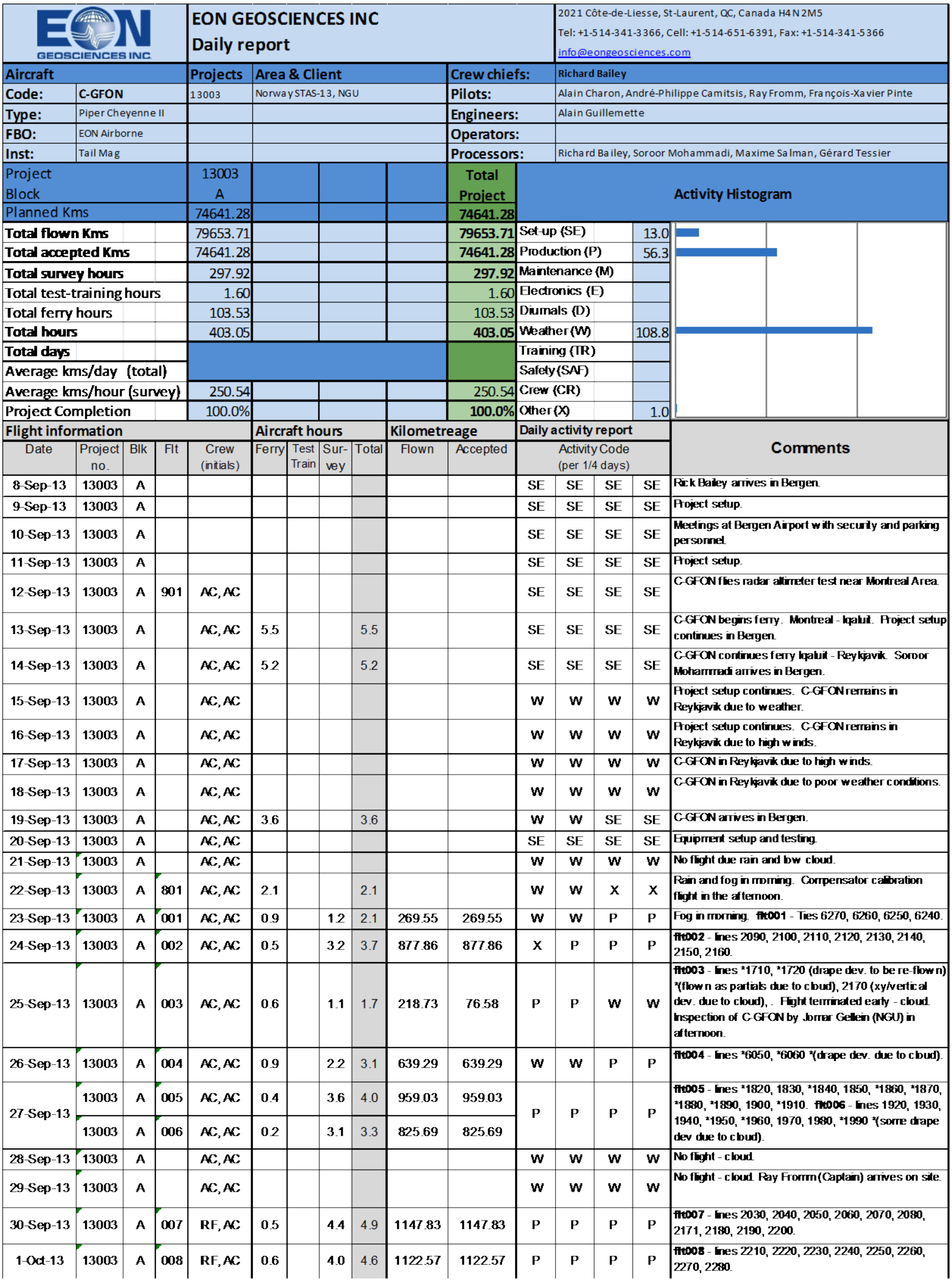
13003 Geological Survey of Norway, Stavenger-Trondheim Aeromagnetic Survey 2013 (STAS-13)

Notes: -All data acquired from Piper Cheyenne II PA-31T aircraft, registration C-GFON.
-Data channels were kept are their original field sampling rate.
-All proper lags have been applied to raw and processed data channels.

Channel Description:

Channel Name	Sampling Rate	Units	Description	Comments
date	01Hz	yyyy/mm/dd	Acquisition date	Start of acquisition, UTC
flt	01Hz		Flight number	
line	01Hz	llln	Line number	lll: planned line number, n: segment code
fid10	10Hz	s	Fiducial	UTC seconds past midnight
hgps	01Hz	hh:mm:ss.ss	Time	UTC
x	01Hz	m	UTM Easting	WGS-84, Z32N, WayPoint PP-DGPS
y	01Hz	m	UTM Northing	WGS-84, Z32N, WayPoint PP-DGPS
z	01Hz	m MSL	GPS altitude	WayPoint PP-DGPS
drape	01Hz	m MSL	Drape altitude	Planned flight surface
raltl	10Hz	m AGL	Radar altitude, raw	Transformed from raw readings
raltlc	10Hz	m AGL	Radar altitude, edited	Corrected for noise, drift, nulled at saturation
raltSRTM	10Hz	m AGL	Radar altitude, published	Aircraft AGL altitude above topoSRTM
raltlf	10Hz	m AGL	Radar altitude, final	Merge of raltSRTM into raltlc at saturation
DTMf	01Hz	m MSL	Digital terrain model, final	DTM model, [z-2.5m-raltlf]
topoSRTM	01Hz	m MSL	Digital terrain model, published	DTM model, NGU source, 3 artefact edits
baltl	01Hz	m MSL	Baro altitude, raw	Computed from raw pressure & temperature
baltlc	01Hz	m MSL	Baro altitude, edited	Corrected for noise
baltlf	01Hz	m MSL	Baro altitude, final	Corrected for drift w.r.t. GPS altitude
baseCo	01Hz	nT	Main magnetic base, raw	
baseC	01Hz	nT	Main magnetic base, edited	Corrected for noise, cultural signal
mfluxX	10Hz	nT	Fluxgate MF-X, raw	Longitudinal vector sensor
mfluxY	10Hz	nT	Fluxgate MF-Y, raw	Transverse vector sensor
mfluxZ	10Hz	nT	Fluxgate MF-Z, raw	Vertical vector sensor
um3l	10Hz	nT	Uncompensated TMF, raw	Cesium sensor 3, lower tail stinger
m3l	10Hz	nT	Compensated TMF, raw	Cesium sensor 3, lower tail stinger
maglc	10Hz	nT	TMF, edited	Corrected for noise, aircraft & cultural signal
mreslc	10Hz	nT	TMF, partial IGRF corrected	Partial IGRF to drape surface removed
mreslct	10Hz	nT	TMF, 1st degree Taylor corrected	Signal from AGL drape deviation removed
mreslcb	10Hz	nT	TMF, diurnal corrected	Zero-average & filtered diurnals removed
mreslvl	10Hz	nT	TMF, levelled	Iterative intersection levelling correction
mreslvl_vg1	10Hz	nT/m	1st vertical gradient of TMF	Traverses only (Oasis magmap1.gx)
mreslvl_vg2	10Hz	nT/m^2	2nd vertical gradient of TMF	Traverses only (Oasis magmap1.gx)
mreslvli	10Hz	nT	IGRF residual of TMF	Model: 2010, date: 2014/02/01, elev: 1308m

Appendix D – Daily Operational Report



EON GEOSCIENCES INC **Daily report**			2021 Côte-de-Liesse, St-Laurent, QC, Canada H4N 2M5 Tel: +1-514-341-3366, Cell: +1-514-651-6391, Fax: +1-514-341-5366 info@eongeosciences.com

Aircraft		**Projects**	**Area & Client**	**Crew chiefs:**	Richard Bailey
Code:	C-GFON	13003	Norway STAS-13, NGU	**Pilots:**	Alain Charon, André-Philippe Camitsis, Ray Fromm, François-Xavier Pinte
Type:	Piper Cheyenne II			**Engineers:**	Alain Guillemette
FBO:	EON Airborne			**Operators:**	
Inst:	Tail Mag			**Processors:**	Richard Bailey, Soroor Mohammadi, Maxime Salman, Gérard Tessier

Project Block	13003 A				**Total Project**	**Activity Histogram**	
Planned Kms	74641.28				**74641.28**		
Total flown Kms	79653.71				**79653.71**	Set-up (SE)	13.0
Total accepted Kms	74641.28				**74641.28**	Production (P)	56.3
Total survey hours	297.92				**297.92**	Maintenance (M)	
Total test-training hours	1.60				1.60	Electronics (E)	
Total ferry hours	103.53				103.53	Diurnals (D)	
Total hours	403.05				**403.05**	Weather (W)	108.8
Total days						Training (TR)	
Average kms/day (total)						Safety (SAF)	
Average kms/hour (survey)	250.54				250.54	Crew (CR)	
Project Completion	100.0%				**100.0%**	Other (X)	1.0

Flight information					**Aircraft hours**				**Kilometreage**		**Daily activity report**				**Comments**
Date	Project no.	Blk	Flt	Crew (initials)	Ferry	Test Train	Sur-vey	Total	Flown	Accepted	Activity Code (per 1/4 days)				
8-Sep-13	13003	A									SE	SE	SE	SE	Rick Bailey arrives in Bergen.
9-Sep-13	13003	A									SE	SE	SE	SE	Project setup.
10-Sep-13	13003	A									SE	SE	SE	SE	Meetings at Bergen Airport with security and parking personnel.
11-Sep-13	13003	A									SE	SE	SE	SE	Project setup.
12-Sep-13	13003	A	901	AC, AC							SE	SE	SE	SE	C-GFON flies radar altimeter test near Montreal Area.
13-Sep-13	13003	A		AC, AC	5.5			5.5			SE	SE	SE	SE	C-GFON begins ferry. Montreal - Iqaluit. Project setup continues in Bergen.
14-Sep-13	13003	A		AC, AC	5.2			5.2			SE	SE	SE	SE	C-GFON continues ferry Iqaluit - Reykjavik. Soroor Mohammadi arrives in Bergen.
15-Sep-13	13003	A		AC, AC							W	W	W	W	Project setup continues. C-GFON remains in Reykjavik due to weather.
16-Sep-13	13003	A		AC, AC							W	W	W	W	Project setup continues. C-GFON remains in Reykjavik due to high winds.
17-Sep-13	13003	A		AC, AC							W	W	W	W	C-GFON in Reykjavik due to high winds.
18-Sep-13	13003	A		AC, AC							W	W	W	W	C-GFON in Reykjavik due to poor weather conditions.
19-Sep-13	13003	A		AC, AC	3.6			3.6			W	W	SE	SE	C-GFON arrives in Bergen.
20-Sep-13	13003	A		AC, AC							SE	SE	SE	SE	Equipment setup and testing.
21-Sep-13	13003	A		AC, AC							W	W	W	W	No flight due rain and low cloud.
22-Sep-13	13003	A	801	AC, AC	2.1			2.1			W	W	X	X	Rain and fog in morning. Compensator calibration flight in the afternoon.
23-Sep-13	13003	A	001	AC, AC	0.9		1.2	2.1	269.55	269.55	W	W	P	P	Fog in morning. **flt001** - Ties 6270, 6260, 6250, 6240.
24-Sep-13	13003	A	002	AC, AC	0.5		3.2	3.7	877.86	877.86	X	P	P	P	**flt002** - lines 2090, 2100, 2110, 2120, 2130, 2140, 2150, 2160.
25-Sep-13	13003	A	003	AC, AC	0.6		1.1	1.7	218.73	76.58	P	P	W	W	**flt003** - lines *1710, *1720 (drape dev. to be re-flown) *(flown as partials due to cloud), 2170 (xy/vertical dev. due to cloud), . Flight terminated early - cloud. Inspection of C-GFON by Jomar Gellein (NGU) in afternoon.
26-Sep-13	13003	A	004	AC, AC	0.9		2.2	3.1	639.29	639.29	W	W	P	P	**flt004** - lines *6050, *6060 *(drape dev. due to cloud).
27-Sep-13	13003	A	005	AC, AC	0.4		3.6	4.0	959.03	959.03	P	P	P	P	**flt005** - lines *1820, 1830, *1840, 1850, *1860, *1870, *1880, *1890, 1900, *1910. **flt006** - lines 1920, 1930, 1940, *1950, *1960, 1970, 1980, *1990 *(some drape dev due to cloud).
	13003	A	006	AC, AC	0.2		3.1	3.3	825.69	825.69					
28-Sep-13	13003	A		AC, AC							W	W	W	W	No flight - cloud.
29-Sep-13	13003	A		AC, AC							W	W	W	W	No flight - cloud. Ray Fromm (Captain) arrives on site.
30-Sep-13	13003	A	007	RF, AC	0.5		4.4	4.9	1147.83	1147.83	P	P	P	P	**flt007** - lines 2030, 2040, 2050, 2060, 2070, 2080, 2171, 2180, 2190, 2200.
1-Oct-13	13003	A	008	RF, AC	0.6		4.0	4.6	1122.57	1122.57	P	P	P	P	**flt008** - lines 2210, 2220, 2230, 2240, 2250, 2260, 2270, 2280.

Flight information					Aircraft hours				Kilometreage		Daily activity report				Comments
Date	Project no.	Blk	Flt	Crew (initials)	Ferry	Test Train	Sur-vey	Total	Flown	Accepted	Activity Code (per 1/4 days)				
2-Oct-13	13003	A	009	RF, AC	0.6		3.2	3.8	906.65	906.65	P	P	P	P	**flt009** - lines 2290, *2300 *(briefly exceeds diurnal spec), 2310, 2320, 2330, 2340.
3-Oct-13	13003	A	010	RF, AC	0.7		3.3	4.0	927.56	927.56	W	P	P	P	**flt010** - Fog in morning. lines 2350, 2360, 2370, 2380, 2390, 2400.
4-Oct-13	13003	A									W	W	W	W	No flight due to rain. Alain Guillemette (AME) arrives on site.
5-Oct-13	13003	A									W	W	W	W	No flight due to rain. Maintenance on C-GFON.
6-Oct-13	13003	A									W	W	W	W	No flight due to rain. Maintenance on C-GFON.
7-Oct-13	13003	A									W	W	W	W	No flight due to rain.
8-Oct-13	13003	A									W	W	W	W	No flight due to rain.
9-Oct-13	13003	A		RF,AC,AG							W	W	W	W	No production flight due to low cloud. Maintenance test flight in afternoon.
10-Oct-13	13003	A	011	RF, AC	0.4		1.6	2.0	20.50		P	P	P	P	**flt011** - Tie *6150, Line *5930 *(large segment of line flown above drape - to be evaluated). **flt012** - lines 5920, 5910, 5900, 5890, 5880, 5870, 5860, 5850, 5840, 5830, 5820, 5810, 5800. Tie 6040.
	13003	A	012	RF, AC	0.7		2.7	3.4	615.57	615.57					
11-Oct-13	13003	A	013	RF, AC	0.8		3.3	4.1	963.95	963.95	P	P	P	P	**flt013** - lines 2410, 2420, 2440, 2450, 2460, 2470. **flt014** lines 2480, 2490, 2500, 2510.
	13003	A	014	RF, AC	0.7		2.3	3.0	666.08	666.08					
12-Oct-13	13003	A	015	RF, AC	0.8		3.5	4.3	1023.78	1023.78	P	P	P	P	**flt015** - lines 2520, 2530, 2540, 2550, 2560, 2570. **flt016** - lines 2580, 2590, 2600, 2610.
	13003	A	016	RF, AC	0.9		2.3	3.2	697.44	697.44					
13-Oct-13	13003	A	017	RF, AC	0.9		3.5	4.4	1083.85	1083.85	W	P	P	P	Fog in morning. **flt017** - lines 2620, 2630, 2640, 2650, 2660, 2670.
14-Oct-13	13003	A									W	W	W	W	No flight due to fog.
15-Oct-13	13003	A									W	W	W	W	No flight due to low cloud.
16-Oct-13	13003	A	018	RF, AC	0.5		0.4	0.9	123.54	111.94	W	P	P	W	**flt018** - lines *2680, *2690 *(flown as partials due to low cloud). Flight terminated due to cloud. **Delivery 1** - **flt001-flt017** uploaded to ftp site.
17-Oct-13	13003	A	019	RF, AC	0.6		2.5	3.1	581.17	548.13	W	P	P	P	Morning cloud. **flt019** - lines *1010, *1011 (acc. re-flight of line 1010), *1020, *1030, 1040, 1050, 1060, 1070, 1080, 1090, 1100, 1110, 1120, 1130, 1140, 1150, *(drape dev - petrol plant) **flt020** - lines 1160, 1170, 1180, 1190, 1200, 1210, 1220, 1230
	13003	A	020	RF, AC	0.5		1.5	2.0	363.29	363.29					
18-Oct-13	13003	A	021	RF, AC	0.2		3.9	4.1	1027.24	1024.64	X	P	P	P	Morning meeting with tower regarding flight through Bergen zone. **flt021** - lines 1670, 1680, 1690, 1700, *1721 *(completed Eastern section of partial), 1730, 1740, 1760, 1770, 1780, 1790, 1800, 1810.
19-Oct-13	13003	A	022	RF, AC	0.9		3.2	4.1	973.30	971.98	W	P	P	P	Low cloud in morning. **flt022** - lines *2680, *2690, 2700, 2710, 2720, 2730 *(completed Eastern end of partial).
20-Oct-13	13003	A	023	RF, AC	1.0		3.1	4.1	922.85	907.75	W	P	P	P	Cloud in mountains in morning. **flt023** - lines *2740, *2750, **2760 **(flown as partial due to cloud), 2770, 2780 *(drape dev on eastern end of line, due to cloud). Khaled Moussaoui arrives in Bergen.
21-Oct-13	13003	A	024	RF, AC	0.4		3.9	4.3	912.47	912.47	P	P	P	P	**flt024** - lines 5650, 5660, 5670, 5680 5690 5700, 5710, 5720, 5730, 5740, 5750, 5760, 5770, 5780, 5790, 5931 (re-flight of 5930 (drape dev.)) *6110, *6120 *(flown as partial due to cloud). **flt025** - lines 5600, 5610, 5620, 5630, 5640, 6090.
	13003	A	025	RF, AC	0.6		2.3	2.9	616.95	616.95					
22-Oct-13	13003	A									W	W	W	W	No flight due to rain.
23-Oct-13	13003	A									W	W	W	W	No flight due to rain.
24-Oct-13	13003	A									W	W	W	W	No flight due to rain. Khaled Moussaoui leaves Bergen.
25-Oct-13	13003	A	026	RF, AC	0.1		3.7	3.8	816.84	816.84	W	W	P	P	Cloud in mountains in morning. **flt026** - lines 1240, 1250, 1260, 1270, 1280, 1290, 1300, 1310, 1320, 1330, 1340, 1350, 1360, 1370
26-Oct-13	13003	A		RF, AC							W	W	W	W	No flight due to rain.
27-Oct-13	13003	A	027	RF, AC	0.8		3.0	3.8	747.02	743.32	W	P	P	P	**flt027** - lines 5510, 5520, 5530, 5540, 5550, 5560, 5570, 5580, 5590, Tie - *6030 *(flown as partial due to cloud). **flt028** - lines 5500, Tie 6010, 6022
	13003	A	028	RF, AC	0.9		1.0	1.9	143.84	143.84					
28-Oct-13	13003	A									W	W	W	W	No flight due to low cloud.
29-Oct-13	13003	A	029	RF, AC	0.3		0.1	0.4			W	W	P	W	**flt029** - line *1380 - SCRUB *(flown as partial due to cloud).Flight terminated due to cloud.
	13003	A	030	RF, AC	0.2			0.2							
30-Oct-13	13003	A	031	RF, AC	0.5		2.5	3.0	630.57	623.32	P	P	P	P	**flt031** - lines *2790, *2800, *2810, *2820, *2830, *2840, *2850,*2860, Tie **6031 **(completed the partial of tie 6030). **flt032** - lines *2870, *2880 *(flown as partial due to cloud)
	13003	A	032	RF, AC	0.6		0.5	1.1	142.17	142.17					
31-Oct-13	13003	A	033	RF, AC	1.3		3.0	4.3	810.61	810.61	W	P	P	P	**flt033** - lines 5400, 5410, 5420, 5430, 5460, 5470, 5480, 5490
	13003	A	034	RF, AC	1.2			1.2							

Flight information					Aircraft hours				Kilometreage		Daily activity report				Comments
Date	Project no.	Blk	Flt	Crew (initials)	Ferry	Test Train	Sur-vey	Total	Flown	Accepted	Activity Code (per 1/4 days)				
1-Nov-13	13003	A	035	RF, AC	1.2		3.0	4.2	827.80	827.80	P	P	P	P	**flt035** - lines 5440, 5450, 5390, 5380, 5370, 5360,5350. **flt036** - lines 5310, 5320, 5330, 5340
	13003	A	036	RF, AC	1.3		1.9	3.2	552.12	552.12					
2-Nov-13	13003	A	037	RF, AC	1.0		3.3	4.3	953.14	953.14	P	P	P	P	**flt037** 5300, 5290, 5270, 5260, 5250, 5240 - lines **flt038** - lines 5220, 5230
	13003	A	038	RF, AC	1.0		1.1	2.1	321.06	321.06					
3-Nov-13	13003	A	039	RF, AC	0.7		2.2	2.9	516.35	516.35	P	P	P	P	**flt039** lines 5180, 5190, 5200, 5210 **.**Tie 6020. **flt040** - lines *1381, 1400 *(completed the partial of 1380). Tie 6070
	13003	A	040	RF, AC	0.5		2.3	2.8	487.80	487.80					
4-Nov-13	13003	A	041	RF, AC	0.7		1.5	2.2	343.84	343.84	W	P	P	W	**flt041**- lines 2890, *2900 *(flown as partials due to low cloud) **flt042** -Tie *6111 *(completed southern section of partial tie 6110)
	13003	A	042	RF, AC	0.6		0.6	1.2	184.74	169.70					
5-Nov-13	13003	A		RF, AC							W	W	W	W	No flight due to low cloud.
6-Nov-13	13003	A	043	RF, AC	0.3		2.9	3.2	768.11	768.11	W	P	P	P	**flt043**- lines 1410, 1420, 1430, 1440, 1450, 1460, 1470, 1480, *1490, *1500 *(drape dev due to windmil)
7-Nov-13	13003	A	044	RF, AC	1.1		2.8	3.9	737.46	681.36	W	P	P	P	**flt044**- lines *5140, *5150, *5160, 5170, **5181, **5191, **5201, **5211. *(flown as partial due to cloud) **(completed Eastern section of partial)
	13003	A	045	RF, AC	1.0			1.0							
8-Nov-13	13003	A	046	RF, AC	1.0		3.0	4.0	818.18	758.27	W	P	P	P	**flt046**- lines 5100, 5110, 5120, 5130, *5141, *5151, *5161 *(completed Eastern section of partial). **flt047**- lines 5080, 5090
	13003	A	047	RF, AC	1.2		1.0	2.2	302.77	302.77					
9-Nov-13	13003	A		RF, AC							W	W	W	W	No flight due to low cloud. Maintenance on C-GFON.
10-Nov-13	13003	A		RF, AC							W	W	W	W	No flight due to low cloud. Maintenance on C-GFON.
11-Nov-13	13003	A		RF, AC							W	W	W	W	No flight due to low cloud. Maintenance on C-GFON.
12-Nov-13	13003	A		RF, AC							W	W	W	W	No flight due to low cloud. Maintenance test flight in morning.
13-Nov-13	13003	A		RF, AC							W	W	W	W	No flight due to low cloud.
14-Nov-13	13003	A		RF, AC							W	W	W	W	No flight due to low cloud.
15-Nov-13	13003	A		RF, AC							W	W	W	W	No flight due to low cloud.
16-Nov-13	13003	A		RF, AC							W	W	W	W	No flight due to low cloud.
17-Nov-13	13003	A	048	RF, AC	0.3		1.2	1.5	304.61	304.61	W	W	P	W	**flt048**- lines *1510, *1520, *1530, *1540, *1550, *1560 *(flown as partial due to cloud)
18-Nov-13	13003	A		RF, AC							W	W	W	W	No flight due to low cloud.
19-Nov-13	13003	A		RF, AC							W	W	W	W	No flight due to low cloud.
20-Nov-13	13003	A	049	RF, AC	0.4		3.9	4.3	1106.57	1106.57	P	P	P	P	**flt049**- lines 5030, 5040, 5050, 5060, 5070, tie 6130. **flt050**- line 5020, tie 6160. Odleiv and Marie-Andree visit Bergen.
	13003	A	050	RF, AC	0.2		2.0	2.2	528.53	528.53					
21-Nov-13	13003	A	051	RF, AC	0.7		3.6	4.3	982.06	982.06	P	P	P	P	**flt051**- lines 4960, 4970, 4980, 5000, 5010, tie *6140 *(flown as partial due to cloud). **flt052**- line 4930, 4940, 4950.
	13003	A	052	RF, AC	1.2		1.7	2.9	481.87	481.87					
22-Nov-13	13003	A	053	RF, AC	0.2		2.2	2.4	572.60	572.60	W	P	P	W	**flt053**- lines 1570, 1580, *1590, *1600,*1610, *1620, *1630, *1640, *1650, *1660 *(flown as partial due to cloud).
23-Nov-13	13003	A		RF, AC							W	W	W	W	No flight due to low cloud.
24-Nov-13	13003	A		RF, AC							W	W	W	W	No flight due to low cloud.
25-Nov-13	13003	A	054	RF, AC	0.8		2.8	3.6	687.40	446.24	W	P	P	W	**flt054**- lines 1390, *1511, *1521, *1531,*1541, *1551, *1561, *1591, *1601, *1621, *1631, *1641, *1651, *1661 *(completed Eastern section of partial lines).
26-Nov-13	13003	A		RF, AC							W	W	W	W	No flight due to low cloud.
27-Nov-13	13003	A		RF, AC							W	W	W	W	No flight due to low cloud.
28-Nov-13	13003	A	055	RF, AC	0.5			0.5			W	W	P	W	The flight was aborted due to low clouds with no production.
29-Nov-13	13003	A		RF, AC							W	W	W	W	No flight due to low cloud.
30-Nov-13	13003	A		RF, AC							W	W	W	W	No flight due to low cloud.
1-Dec-13	13003	A		RF, AC							W	W	W	W	No flight due to low cloud.
2-Dec-13	13003	A		RF, AC							W	W	W	W	No flight due to low cloud.
3-Dec-13	13003	A		RF, AC							W	W	W	W	No flight due to low cloud.
4-Dec-13	13003	A		RF, AC							W	W	W	W	No flight due to low cloud.
5-Dec-13	13003	A		RF, AC							W	W	W	W	No flight due to low cloud.
6-Dec-13	13003	A		RF, AC							W	W	W	W	No flight due to low cloud.
7-Dec-13	13003	A		RF, AC							W	W	W	W	No flight due to low cloud.
8-Dec-13	13003	A		RF, AC							SE	SE	SE	SE	Crew demobilized from Norway. Project halted due to poor weather conditions and shortening days.
28-Jan-14	13003	A		RF, AC							SE	SE	SE	SE	Crew (Max Salman, Ray Fromm) returned to Norway. Project restarted.

Flight information					Aircraft hours				Kilometreage		Daily activity report				Comments
Date	Project no.	Blk	Flt	Crew (initials)	Ferry	Test Train	Survey	Total	Flown	Accepted	Activity Code (per 1/4 days)				
29-Jan-14	13003	A		RF, AC							SE	SE	SE	SE	Mag base stations setup. André-Philippe Camitsis arrives on-site.
30-Jan-14	13003	A	056	RF, AC	0.7	0.4		1.1			SE	SE	SE	SE	GPS base station setup. FOM flight in the afternoon: POOR.
31-Jan-14	13003	A	057	RF, AC	1.0	1.2		2.2			SE	SE	W	W	FOM flight in the morning. Low cloud in the afternoon.
1-Feb-14	13003	A	058	RF, AC	1.1		1.1	2.2	267.90	267.90	P	W	W	W	**flt058**- lines 2910-2920 (partials), cut short due to low cloud and heavy turbulence.
2-Feb-14	13003	A									W	W	W	W	No flight due to low cloud.
3-Feb-14	13003	A	059	RF, AC	1.1		3.5	4.6	963.66	963.66	P	P	P	P	**flt059**- lines 4870-4920. **flt060**- lines 4830-4840, 4850-4860 (partials).
	13003	A	060	RF, AC	1.2		1.9	3.1	531.79	531.79					
4-Feb-14	13003	A	061	RF, AC	1.0		2.1	3.1	559.50	559.50	P	P	P	P	**flt061**- lines 4770-4820 (partials). **flt062**- lines 4730-4760 (partials).
	13003	A	062	RF, AC	1.2		1.2	2.4	332.20	332.20					
5-Feb-14	13003	A	063	RF, AC	0.7		4.1	4.8	1127.50	1127.50	P	P	P	P	**flt063**- lines 2930-3020 (partials). **flt064**- lines 3030-3050 (partials).
	13003	A	064	RF, AC	0.5		1.8	2.3	498.90	498.90					
6-Feb-14	13003	A	065	RF, AC	1.2		1.6	2.8	451.10	451.10	P	W	W	W	**flt065**- lines 3060-3090 (partials), cut short due to low cloud and heavy turbulence.
7-Feb-14	13003	A		RF, AC							W	W	W	W	No flight due to low cloud.
8-Feb-14	13003	A		RF, AC							W	W	W	W	No flight due to low cloud and freezing fog.
9-Feb-14	13003	A		RF, AC							W	W	W	W	No flight due to low cloud.
10-Feb-14	13003	A		RF, AC							W	W	W	W	No flight due to low cloud.
11-Feb-14	13003	A	066	RF, AC	1.0		3.1	4.1	878.02	714.50	P	P	P	P	**flt066**- lines 4670-4700, 4710-4720 (partials). **flt067**- lines 4600-4630, 4640 & 4660 (partials)
	13003	A	067	RF, AC	1.1		2.7	3.8	765.34	735.73					
12-Feb-14	13003	A		RF, AC							W	W	W	W	No flight due to low cloud.
13-Feb-14	13003	A		RF, AC							W	W	W	W	No flight due to low cloud, and severe turbulence.
14-Feb-14	13003	A		RF, AC							W	W	W	W	No flight due to low cloud.
15-Feb-14	13003	A		RF, AC							W	W	W	W	No flight due to low cloud.
16-Feb-14	13003	A		RF, AC							W	W	W	W	No flight due to low cloud.
17-Feb-14	13003	A		RF, AC							W	W	W	W	No flight due to low cloud.
18-Feb-14	13003	A	068	RF, AC	0.5		3.1	3.6	826.92	688.78	P	P	P	P	**flt068**- lines 1710*, 1720*, 2760*, 2790*, 2800*, 2900*, 2910*, 2920*, Tie 6230 **flt069**- 3010*-3070*, Tie 6220 (*Completed partials)
	13003	A	069	RF, AC	0.9		2.4	3.3	627.69	539.03					
19-Feb-14	13003	A	070	RF, AC	0.4		3.7	4.1	915.31	898.11	P	P	P	P	**flt070**- lines 2810*, 2820*, Ties 6080, 6100 **flt071**- lines (3100 - 3140)** (*Partial lines) (**Completed partials)
	13003	A	071	RF, AC	0.7		3.7	4.4	1041.79	1002.99					
20-Feb-14	13003	A	072	RF, AC	0.7		3.2	3.9	770.31	723.93	P	P	W	W	**flt072**- (2810, 2820)**, 3150, 3160, 3170* (*Partial lines) (**Completed partials)
21-Feb-14	13003	A		RF, AC							W	W	W	W	No flying due to low clouds.
22-Feb-14	13003	A		RF, AC							W	W	W	W	No flying due to low clouds.
23-Feb-14	13003	A		RF, AC							W	W	W	W	No flying due to low clouds.
24-Feb-14	13003	A		RF, AC							W	W	W	W	No flying due to low clouds.
25-Feb-14	13003	A	73	RF, AC	1.2		2.8	4.0	718.16	718.16	P	P	P	P	**flt073**- lines 4540, 4540, (4560-4590)* **flt074**- lines (4450-4490)*, (4510,4530)* (*Partial lines)
	13003	A	74	RF, AC	1.2		2.4	3.6	633.30	633.30					
26-Feb-14	13003	A	75	RF, AC	1.4		1.4	2.8	375.80	375.80	W	W	P	W	**flt075**- lines 3180*, (3230-3250)* (*Partial Lines) Flight terminated early due to low cloud and turbulence.
27-Feb-14	13003	A		RF, AC							W	W	W	W	No flying due to low clouds.
28-Feb-14	13003	A		RF, AC							W	W	W	W	No flying due to low clouds.
1-Mar-14	13003	A	76	RF, AC	1.8		2.8	4.6	793.20	793.20	W	W	P	P	**flt076**- lines (4360-4400, 4420-4440)* (*Partial Lines)
2-Mar-14	13003	A	77	RF, AC	1.3		0.3	1.6	88.10	88.10	W	W	P	W	**flt077**- lines (3260, 3270)* (*Partial Lines)
3-Mar-14	13003	A		RF, AC							W	W	W	W	No flying due to low clouds.
4-Mar-14	13003	A		RF, AC							W	W	W	W	No flight due to low cloud. Maintenance on C-GFON
5-Mar-14	13003	A		RF, AC							W	W	W	W	No flight due to low cloud. Maintenance on C-GFON
6-Mar-14	13003	A		RF, AC							W	W	W	W	No flight due to low cloud. Maintenance on C-GFON
7-Mar-14	13003	A		RF, AC							W	W	W	W	No flight due to low cloud. Maintenance on C-GFON
8-Mar-14	13003	A	78	RF, AC							W	W	P	W	The flight w as aborted due to low clouds w ith no production.
9-Mar-14	13003	A		RF, AC							W	W	W	W	No flight due to low cloud.
10-Mar-14	13003	A		RF, AC							W	W	W	W	No flight due to low cloud.
11-Mar-14	13003	A	79	RF, AC	1.2		3.5	4.7	907.57	820.40	W	P	P	P	**flt079**- lines 4320-4350, (4360-4390)** **flt080**- line 4310 (**Completed Partials)
	13003	A	80	RF, AC	1.0		0.5	1.5	152.13	152.13					
12-Mar-14	13003	A	81	RF, AC	0.6		3.6	4.2	869.95	865.75	W	P	P	W	**flt081**- lines 3000**, (3280,3290,3310-3360)*, Tie lines T6210 (*Partial Lines **Completed Partials). Return flight to Bergen after refuel, no production.
13-Mar-14	13003	A		RF, AC							W	W	W	W	No flight due to low cloud.
14-Mar-14	13003	A		RF, AC							W	W	W	W	No flight due to low cloud.

Flight information					Aircraft hours				Kilometreage		Daily activity report				Comments
Date	Project no.	Blk	Flt	Crew (initials)	Ferry	Test Train	Sur-vey	Total	Flown	Accepted	Activity Code (per 1/4 days)				
15-Mar-14	13003	A		RF, AC							W	W	W	W	No flight due to low cloud.
16-Mar-14	13003	A		RF, AC							W	W	W	W	No flight due to low cloud.
17-Mar-14	13003	A		RF, AC							W	W	W	W	No flight due to low cloud.
18-Mar-14	13003	A		RF, AC							W	W	W	W	No flight due to low cloud.
19-Mar-14	13003	A		RF, AC							W	W	W	W	No flight due to low cloud and fog.
20-Mar-14	13003	A		RF, AC							W	W	W	W	No flight due to low cloud and freezing fog.
21-Mar-14	13003	A		RF, AC							W	W	W	W	No flight due to low cloud, fog, heavy rain, hail.
22-Mar-14	13003	A	82	RF, AC	1.9		1.8	3.7	464.52	464.52	W	P	P	W	**flt082**- lines 4300, (4290-4270)* (*Partial Lines)
23-Mar-14	13003	A		RF, AC							W	W	W	W	No flight due to low cloud.
24-Mar-14	13003	A	83	RF, AC	1.1		0.2	1.3	54.69	54.69	P	P	P	P	**flt083**- lines 4260* **flt084**- lines 4259, (4510-4550, 4640, 4660, 4710, 4720, 4760-4800, 4860)** (*Partial Lines **Completed Partials)
	13003	A	84	RF, AC	0.4		4.5	4.9	1198.41	945.78					
25-Mar-14	13003	A	85	RF, AC	0.5		4.4	4.9	1216.05	953.55	P	P	P	P	**flt085**- lines 4240, 4400**, 4430**, (4450-4490)**, (4730-4750)**, 4810**, 4820**, 4850** **flt086**- lines 4200-4230, 4410, 4420** 4440**, (4260-4290)** (**Completed Partials)
	13003	A	86	RF, AC	0.4		4.3	4.7	1176.18	1088.24					
26-Mar-14	13003	A	87	RF, AC	0.4		3.8	4.2	1078.90	1066.26	P	P	P	P	**flt087**- lines 4120, 4130*, 4140*, 4150-4190 **flt088**- lines (4040-4110)*, 4130**, 4140** (*Partial Lines **Completed Partials)
	13003	A	88	RF, AC	0.5		4.2	4.7	1218.96	1182.61					
27-Mar-14	13003	A	89	RF, AC	0.5		3.6	4.1	1103.98	1103.98	P	P	P	P	**flt089**- lines (3960-4030)* **flt090**- lines (3900-3950)* (*Partial Lines)
	13003	A	90	RF, AC	0.5		3.1	3.6	941.54	941.54					
28-Mar-14	13003	A	91	RF, AC	0.6		3.6	4.2	1078.89	1078.89	P	P	P	P	**flt091**- lines (3800-3890)* **flt092**- lines (3740-3790)* (*Partial Lines)
	13003	A	92	RF, AC	0.7		2.0	2.7	611.47	611.47					
29-Mar-14	13003	A	93	RF, AC	0.7		2.6	3.3	834.77	834.77	P	P	P	P	**flt093**- lines 3700-3730 **flt094**- lines 3690, 3680*, T6120**, T6170 (*Partial Lines **Completed Partials)
	13003	A	94	RF, AC	0.5		3.5	4.0	897.00	882.14					
30-Mar-14	13003	A	95	RF, AC	0.8		3.3	4.1	1052.98	1052.98	P	P	P	P	**flt095**- lines 3370-3410 **flt096**- lines (3420-3450)* (*Partial Lines)
	13003	A	96	RF, AC	0.9		1.3	2.2	349.94	349.94					
31-Mar-14	13003	A	97	AC, AC	1.3		2.1	3.4	452.22	435.12	W	P	P	W	**flt097**- lines 2000-2020, 2430
1-Apr-14	13003	A	98	FX, AC	1.1		2.9	4.0	572.30	458.50	P	P	P	P	**flt098**- lines (4020-4110)** **flt099**- lines (3900-4000)** (**Completed Partials)
	13003	A	99	FX, AC	0.6		3.0	3.6	613.30	486.04					
2-Apr-14	13003	A		FX, AC							W	W	W	W	No flight due to low cloud.
3-Apr-14	13003	A	100	FX, AC	1.0		3.2	4.2	863.20	714.60	P	P	P	P	**flt100**- lines (3820-3890)**, 4030** **flt101**- lines 3360, (3740-3810)** (**Completed Partials)
	13003	A	101	FX, AC	0.9		3.8	4.7	1104.60	984.53					
4-Apr-14	13003	A	102	FX, AC	0.3		2.8	3.1	809.08	789.09	P	P	P	P	**flt102**- lines (3260, 3270)**, (3650, 3660)*, 3670 **flt103**- lines (3080, 3080, 3180, 3230-3250)**, 3460 (*Partial Lines **Completed Partials)
	13003	A	103	FX, AC	0.4		3.7	4.1	1014.99	915.64					
5-Apr-14	13003	A		FX, AC							W	W	W	W	No flight due to low cloud. Maintenance on C-GFON
6-Apr-14	13003	A		FX, AC							W	W	W	W	No flight due to low cloud. Maintenance on C-GFON
7-Apr-14	13003	A		FX, AC							W	W	W	W	No flight due to low cloud. Maintenance on C-GFON
8-Apr-14	13003	A		FX, AC							W	W	W	W	No flight due to low cloud. Maintenance on C-GFON
9-Apr-14	13003	A		FX, AC							W	W	W	W	No flight due to low cloud.
10-Apr-14	13003	A		FX, AC							W	W	W	W	No flight due to low cloud.
11-Apr-14	13003	A		FX, AC							W	W	W	W	No flight due to low cloud.
12-Apr-14	13003	A		FX, AC							W	W	W	W	No flight due to low cloud.
13-Apr-14	13003	A		FX, AC							W	W	W	W	No flight due to low cloud.
14-Apr-14	13003	A		FX, AC							W	W	W	W	No flight due to low cloud.
15-Apr-14	13003	A	104	FX, AC							W	W	W	W	The flight was aborted due to low clouds with no production.
16-Apr-14	13003	A		FX, AC							W	W	W	W	No flight due to low cloud.
17-Apr-14	13003	A		FX, AC							W	W	W	W	No flight due to low cloud.
18-Apr-14	13003	A	105	FX, AC	0.7		3.3	4.0	974.49	943.56	P	P	P	P	**flt105**- lines 3450**, (3470-3500)*, 3510 **flt106**- lines 3520-3540, (3550, 3560*), 3570
	13003	A	106	FX, AC	0.5		3.7	4.2	1106.26	1106.26					
19-Apr-14	13003	A	107	FX, AC	0.5		3.6	4.1	1013.35	999.63	P	P	P	P	**flt107**- (3550-3560)**, 3580-3610 **flt108**- 3620-3640, 3650** (**Completed Partials)
	13003	A	108	FX, AC	0.3		2.8	3.1	842.34	719.54					
20-Apr-14	13003	A	109	FX, AC	0.5		3.3	3.8	773.19	491.27	P	P	P	P	**flt109**- lines (3350, 3340, 3660, 3680, 3740)** **flt110**- lines (3330, 3420-3440, 4620, 4630, 4670-4700)** **flt111**- lines (2990, 3000, 3320)**, 3190 (*Partial Lines **Completed Partials)
	13003	A	110	FX, AC	0.8		3.5	4.3	782.10	648.30					
	13003	A	111	FX, AC	0.6		2.0	2.6	546.46	427.00					
21-Apr-14	13003	A	112	FX, AC	0.7		3.7	4.4	1052.02	955.31	P	P	P	P	**flt112**- lines (2930-2980)**, 3200, 3210 **flt113**- lines (2830-2880)**, 3220 (*Partial Lines **Completed Partials)
	13003	A	113	FX, AC	1.0		3.6	4.6	998.52	908.72					

Flight information					Aircraft hours				Kilometreage		Daily activity report				Comments
Date	Project no.	Blk	Flt	Crew (initials)	Ferry	Test Train	Sur-vey	Total	Flown	Accepted	Activity Code (per 1/4 days)				
22-Apr-14	13003	A	114	FX, AC	0.5		3.7	4.2	799.23	708.74	P	P	P	P	**flt114**- lines 3310, (3470-3500)**, 4120**, 4500, 4650 **flt115**- lines (1950, 1960, 1990)**, (3170, 3280, 3290, 3300), Tie T6150* (*Partial Lines **Completed Partials)
	13003	A	115	FX, AC	0.5		3.4	3.9	921.10	726.43					
23-Apr-14	13003	A	116	FX, AC	0.5		3.7	4.2	836.39	572.88	P	P	P	P	**flt116**- lines (4880, 4870, 4940)**, 4990, 5280, Tie T6200 **flt117**- lines (1840, 1860, 1890, 1910)**, Tie T6180 (**Completed)
	13003	A	117	FX, AC	0.7		2.3	3.0	624.50	351.90					
24-Apr-14	13003	A	118	FX, AC	0.5		2.6	3.1	676.69	559.12	P	P	P	P	**flt118**- Ties T6110, (T6150)**, T6190-6192 **flt119**- Ties T6050, T6130 (*Partial Lines **Completed Partials)
	13003	A	119	FX, AC	0.5		2.4	2.9	648.18						
25-Apr-14	13003	A													Survey completed.
26-Apr-14	13003	A													C-GFON begins ferry back to Montreal.