CO/SO2 operation on N42RF for SENEX 2013

For 2013, the CO instrumentation is contained in a pod located on the left wing inboard of engine number 2 (Station 12, LWS83). The instrument consists of a VUV fluorimeter, a vacuum/sample pump, compressed gas cylinders, and a data system and computer. The computer in the wing pod boots when electrical power is supplied to the pod. Data acquisition software starts automatically. Communication with the pod is by means of 100 base T ethernet.

The SO2 instrumentation is located in a one bay rack at flight station 6. It consists of a TECO model 43C pulsed fluorimeter, an external sample pump, a rack mounted computer and associated data system interface box, a tray with two size 30 compressed gas cylinders containing zero air and a 10 ppm SO2/N2 calibration standard, and a calibration system mounted on the sample inlet. A plug strip inside the rack, above the bottles provides power to the rack.

Both instruments are controlled using the data acquisition interface running on the rack-mounted computer at Sta. 6. Operator intervention consists of opening the cylinder and regulator valves on the on-board gas cylinders, powering up both systems, starting the data acquisition software on the SO2 computer, establishing the connection between the local and remote data acquisition systems, and issuing simple point and click commands to begin the start-up procedures for both instruments. Further operation is autonomous. The transition to ambient sampling once the plane is airborne and instrument shut-down at the conclusion of the flight is actuated by the plane's Weight-Off-Wheels 28 VDC (for SO2) or by a switch at the flight scientist's station (for CO). At the end of the flight, the operator will store and download the data from each instrument, power down both systems and close the valves on the two on-board gas cylinders at Sta. 6.

Both computers record data and control their respective instruments using the data acquisition program DaqFactory. It provides a graphical display of data and programmed and manual control of instrument functions. A list the various programmatic elements can be is displayed by typing <ctrl w>. This displays network connections, data channels, data logging sets, arithmetic conversions to engineering units, programmed subroutines (sequences), and a list of display pages.

Pages 0-4 display SO2 instrument status and provide access to control:

        page 00:   instrument control objects (sequences and relays)

        page 01:   temperatures

        page 02:   flows and pressures

        page 03:   fluorescence and flashlamp excitation intensity count rates

        page 04:   30 minute SO2 mixing ratio time series based on in-situ calibration

Pages 10-16 display CO data and control:

        page 10:   pod status; relay state; sequence operation

        page 11:   instrument temperatures

        page 12:   flows and pressures

        page 13:   compressed gas cylinder pressures

        page 14:   instrument control

        page 15:   fluorescence and excitation intensity count rates

        page 16:   30 minute CO mixing ratio time series based on in-situ calibration

Typing the page number displays the pages 0-9; <shift>number displays 10-19.

The program uses simple routines (sequences) to provide instrument control. Sequences can be called by other sequences to provide automatic control of the operation of the instrument. They can also be activated manually. On the left side of each page is a column of all the sequences that control various instrument functions. Clicking on the name of a sequence activates that sequence. Clicking again stops it.

Start Up procedure (2-3 hours prior to T.O.):

Attach zero air umbilical from ground cylinder to quick-connect on z.a. regulator in Sta. 6 rack.

Power to CO wing pod (after informing flight tech):

        Left Wing 400 Hz Bus 1 <u>ON</u>

        Left Wing WS83 15A breaker <u>ON</u>

Power to Sta. 6 rack:

        turn <u>ON</u> plug strip inside rack above gas cylinders

        confirm data system <u>ON</u>

Open bottle and regulator valves on both gas bottles.

Turn <u>ON</u> rack mount computer.

        after OS (W2K) has loaded, confirm that the time client software is running and has synched with the aircraft time server.

Start DaqFactory (shortcut icon, StaX_2006, middle of screen)

        Verify data system reading correctly (sensible readings pp 1&2). If not, restart program.

        Establish connection to pod (<ctrl>w, click connection **pod**, click "reset connection" until packets received).

Begin SO2 Start Up procedure:

        Page 3, upper left; click the text SO2 Start:Waiting; display changes to SO2 Start:Running. After about 6 minutes, text TECO: OFF flashes and reads TECO:TURN ON; do so. Text reads TECO:ON; flash lamp voltage and fluorescence and excitation count rates begin to read. Pre-flight calibration begins after 5 more minutes.

Begin CO Start Up procedure (~1.5 hours before T.O.):

        Page 10, confirm pump temp > 0°C

        Page 14, middle; click text CO Start Sequence:waiting; text changes to CO Start Sequence:Started. After about 5 minutes the resonance lamp ignites; after another 5 minutes pre-flight calibration starts.

At Aircraft Block-Out:

  Page 3, left; click text SO2 Blockout:Stopped

  text changes briefly to SO2 Blockout:RUNNING. Calibration stops, flows are

  reduced, while waiting for take off.

Disconnect ground air umbilical at quick-connect and remove from plane.

After T.O.:

Transition to ambient sampling for both instruments should be automatic upon take-off.

If either instrument appears to be still running on zero air:

  CO: page 14, middle; Click text Turn Zero Air Off:, text changes to Turn Zero

  Air Off:OFF

  SO2: page 3, left; Click SO2 InFlight:Stopped. Display changes to SO2

  InFlight:RUNNING while the sequence executes.

Check that the Check WoW sequences are running on both instruments:

  CO: page 14, upper middle; Check WoW:Running

  SO2: page 3, upper right; SO2_AC_WoW:## (the current line of the sequence)

Both instruments can have their automatic calibration sequences temporarily interrupted

to insure ambient sampling during plume intercepts:

  CO: page 15, left; CO Amb Measure:

  SO2: page 3, left; set SO2 ambient:

in both cases, automatic calibrations resume after 15 minutes

After landing:

Instrument shut down upon landing is automatic. If shut down sequences have failed to

run on either instrument:

  CO: page 14, lower middle; click text CO ShutDown Sequence:Stopped.

  text changes to CO ShutDown Sequence:RUNNING while sequence executes.

  SO2: page 3, left; click text SO2 Instr. ShutDown:Stopped, text changes to SO2

  Instr. ShutDown:RUNNING while sequence executes. When sequence has

  finished (display reverts to SO2 Instr. ShutDown:Stopped);

Turn TECO off.

Exit DaqFactory on the Sta. 6 computer.

Shut Down CO wing pod:

Run VNC (shortcut icon on desktop) to connect to pod computer.

    IP: 10.43.16.40

    password: pod

Stop DaqFactory:

    Right-click on DaqFactory icon in taskbar; click **Exit**

Collect data:

    Open directory to **C:/DaqFactory/data/texas06**

    Make a new folder named flt_*yymmdd* based on the flight's date

    Drag all the day's data files into the new folder

Collapse the pod VNC window

On Sta. 6 computer, open directory **C:/DaqFactory/data/texas06**, make a folder, flt_*yymmdd*, and drag the day's data into it.

The pod's C: drive is mounted as a network drive (E:). Open it and Copy the day's flight data folder to **C:/DaqFactory/data/pod_data**.

Open the pod VNC window, and choose Shut Down Computer from the Window's Start Menu. The VNC window disappears as pod computer shuts down.

After about a minute, shut off power to the wing pod (WS465 breaker OFF)

Shut Down SO2 instrument:

Copy both the day's **SO2 data folder** and **CO data folder** to appropriate folders on a USB memory stick using the USB port on the front of the Sta. 6 computer.

Shut down the Sta. 6 computer

CLOSE cylinder and regulator valves on the 2 gas bottles in the rack.

Turn OFF plug strip inside Sta. 6 rack.