**Incident Report : Leap Second event causing timing errors in recording.**

**23rd July 2015 Andrew Grace and Richard Barnwell.**

**Abstract**

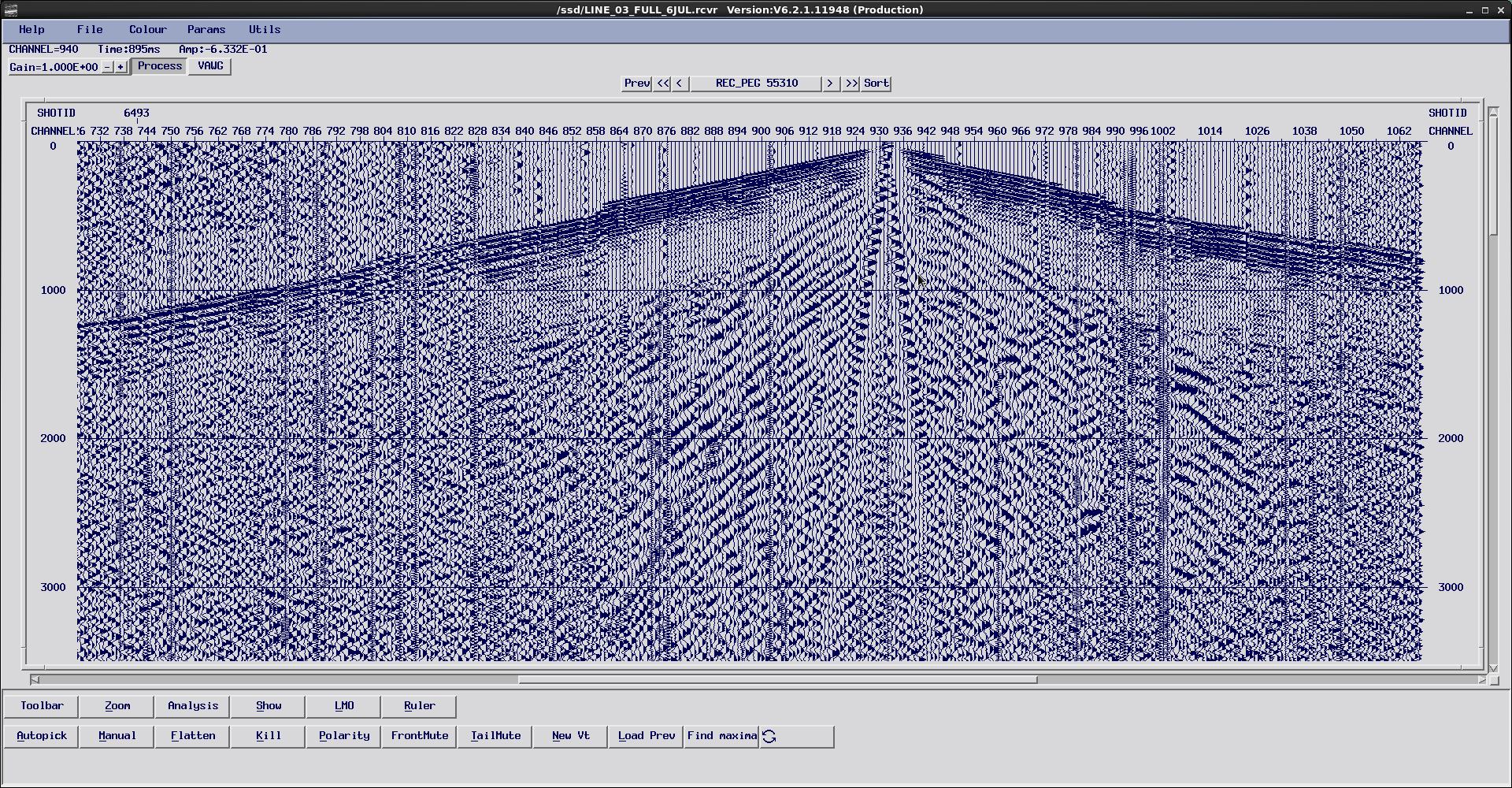
A leap second adjustment occurred on the 30th of June, 23:59:60 UTC, 1st July 9:59:60 AEST. This resulted in a shift of one second in part of the seismic data harvested from the Fairfield Nodal system. The cause is believed to be a mismatch between the times recorded in the Nodes relative to the times recorded by the source vehicle. The nodal system uses GPS time stamps that are used by both the nodes and source vehicle to match start times for the slicing of seismic data in the harvester. A mismatch results in incorrectly harvested data, offset by one second.

Terrex were aware of the potential leap second issue, and installed a software patch on the 15th June 2015 (supplied by Fairfield) in the nodal system to mitigate the problem. However the issue still persisted on some of the nodes.

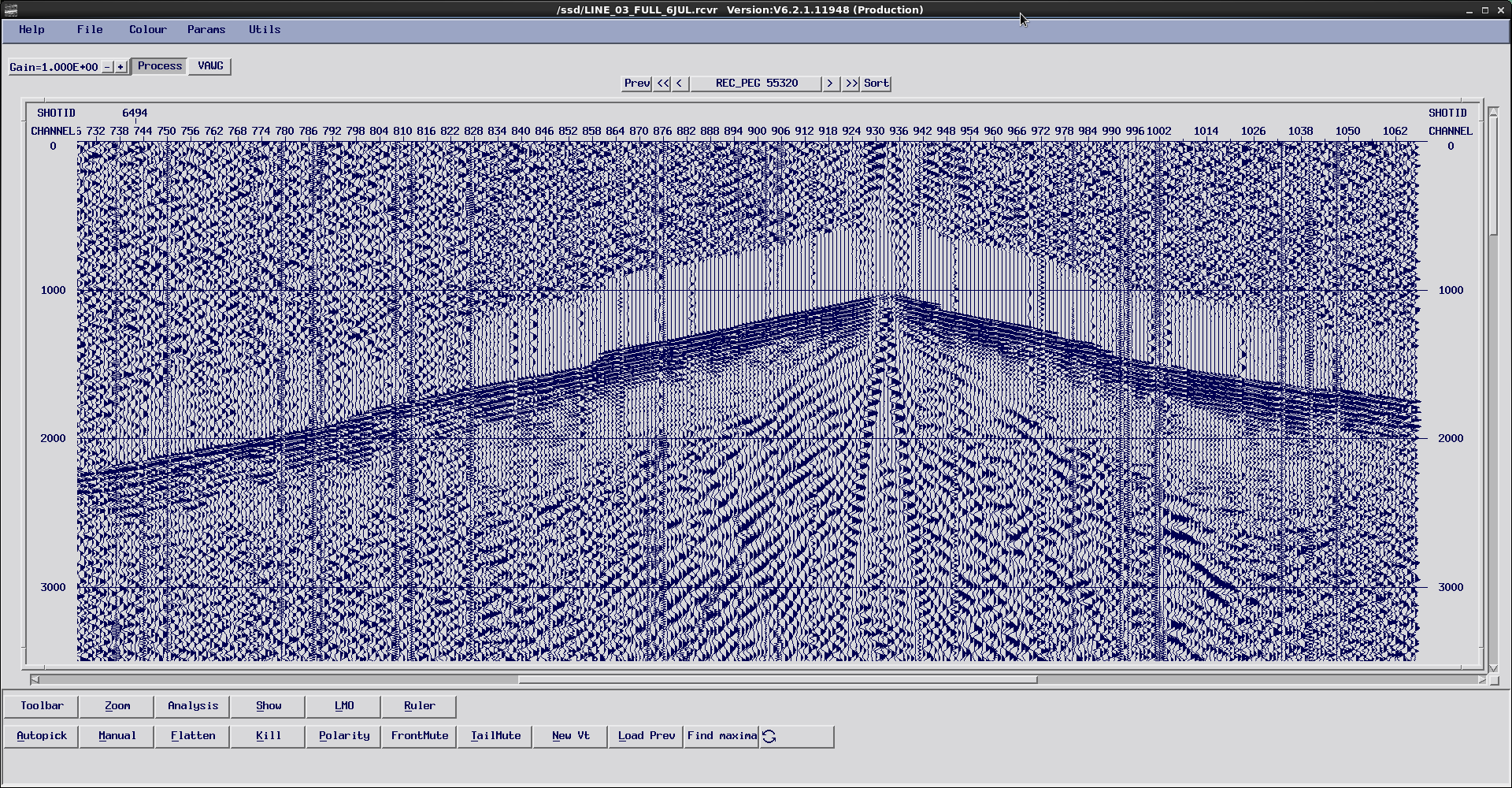
**Observations**

After the leap system a mismatch in the timing of some of the nodes in reference to the source occurred leading to apparent shifts in the sliced data as can be seen as follows.

The following is as expected with first breaks approaching zero time at the near offsets. (Unshifted data).



The following is an example record where the data for all shots recorded by the node appears delayed by 1 seconds.



**Correcting the SBS files for Harvester**

The SBS file is generated by the source vehicle and describes the GPS start-time of each shot, it is imported into the harvester to slice the recorded data into traces corresponding to the shots.

An initial harvest run using the unedited SBS file was undertaken to determine affected records. Each record was assigned, a “sweep-type” as follows:

Sweep Type 0 = Unshifted Data

Sweep Type 1 = Scenario 1 shifts (All Shots in the record delayed 1 second).

A second harvesting run was then undertaken using an edited SBS file with up to three entries from each shot.

A Sweep Type 0 version with the original shotpoint start-times from the source vehicle.

Where the entries for Sweep\_Type 1 had a second added to each shotpoint start time (in red font below).

The entries for Sweep Type 2 had the same adjustment, but only for the shots that were shifted. The harvester requires a unique time of shot for all events, to meet this criteria an additional microsecond was added to all shots in Sweep Type 2 (in yellow highlight below)., Without this modification the harvester would have only harvested the 1 second shifted data leading to an incomplete record.

30005.00 1435636762.496001 03:59:22.496000 2015:06:30 0 [OK] 0 [OK] 0.0 [OK] 3.00 5266

30015.00 1435636803.744001 04:00:03.744000 2015:06:30 0 [OK] 0 [OK] 0.0 [OK] 3.00 5267

30025.00 1435636849.256001 04:00:49.256000 2015:06:30 0 [OK] 0 [OK] 0.0 [OK] 3.00 5268

This caused the harvester to commence slicing of the record 1 second later thereby matching the start time of the node to the actual start time of the shot.

The data shipped as SEGD conts up to three traces per station. With corresponding SWEEP\_TYPE indices of 0, 1 and 2 respectively, allowing for selection of the shift type. A selection file containing the types was shipped with the data.

**Processing**

During the pre-processing of the data, the receiver records were selected by the sweep type corresponding to which of the 3 situations the record belonged to, ie Unshifted or shifted. This was done prior to generating the SEGY shot gathers for export and prior to processing the field stacks.

The SEGY data shipped is a standard SEGY data set. The selection of shifted and non-shifted data was undertaken prior to this step.

The SEGD Data is supplied in receiver gather format with each receiver gather containing between two and three SWEEP indexes, these being 0, 1 and 2. The 0 is the unadjusted data which will represent the majority of data to use in processing. The indexes 1 and 2 represent data that was ‘recut’ from the harvester to adjust for the time shift. The correct index to use is listed in the file

Leap\_node\_index.sfl

Using the wrong indexes will result in shifted data being included into the dataset. Discard the indexes **NOT** listed in the attached Leap\_node\_index file.