depicted in Table 5-3, except that the data stream and TASI fields will be set to the "N/A" (not applicable) value. The time quality field will be set to actual time. The ground station field in the DDS packet header will also be set to the "N/A" value for all auxiliary files, apart from the command history file, where it will correspond to the ground station field in the packet data.

The catalogue entry for an auxiliary data source is the same as for the telemetry data sources.

## E.1 : Long Term Orbit File (LTOF)

The LTOF will contain orbital state vectors for the remaining, a maximum of 4, major phases of the Cluster mission, that is, Cusp 1, Tail 1, Cusp 2 and Tail 2. There will be only one file for each spacecraft, covering the remaining phases. The file will be generated after each constellation manoeuvre phase.

The file is not intended for direct interpretation, but via access by the Fortran routine supplied (see Appendix F.5.1).

The content and format of the file is defined in the following tables. The shaded rows define the format and are followed by the parameter names in an unshaded row. The format definition in brackets follows the ANSI FORTRAN notation for format statements (e.g. A29 means 29 ASCII characters, 5X means 5 spaces, I2 means a 2 character denary integer and F7.2 means a 7 character fixed point number with 2 decimal characters).

For each period of time there is a header, the same as that used for telemetry packets as defined in Table 5-3 followed by a leader block as shown in Table E-2, this is further followed by a number of polynomial coefficient blocks as shown in Table E-3. The number of blocks depending upon the accuracy that is required. The SCET field in the DDS packet header has the same time value as the time in the **SRTTIM** field defined below (although the former is expressed in binary and the latter in ASCII), and this is used as the access key for the file.

| S/C/ ID> (I3, X2) | <Predict or recon.> (A1, X2) | <Generation time> (A20, X2) | <Data start time> (A20, X2) | <Data end time> (A20) | LF (A1) |
|---|---|---|---|---|---|
| **SCID** | **PREREC** | **GENTIM** | **SRTTIM** | **ENDTIM** | **LF** |

| Rec ID> (I3) | <MJD start> (F12.6) | <MJD end> (F12.6) | <MJD orbit> (F15.9) | <Rev. num.> (F11.3) | <Semimaj or axis> (F13.5) | <Mean motion> (F13.5) | LF (A1) |
|---|---|---|---|---|---|---|---|

| NREC | DAYBEG | DAYEND | EPOCH | ORBIN | SMAXIS | OMOTIN | LF |
|---|---|---|---|---|---|---|---|
| Rec ID> (I3) | <x-y-z of position vector> (3F11.3) | | <x-y-z of velocity vector> (3F11.7) | | <Absolute position> (F11.3) | | LF (A1) |
| **NREC** | **XYZPOS(3)** | | **XYZVEL(3)** | | **RDIST** | | **LF** |

*Table E-2 Definition of the Leader Block Within the Long Term Orbit File*

Where:

**SCID** will contain the S/C body identification, this is an integer from 1 to 4 inclusive. The SCID shall be assigned before launch to each physical spacecraft, and remain the same throughout the mission.

**PREREC** a single character flag indicating if the data is predicted (P**) or reconstituted (**R**).**

**GENTIM** date and time when the leader block was written to the file in CCSDS time code A format (YYYY-MM-DDThh:mm:ssZ**).**

**SRTTIM** date and time of the start of the period for when the data is valid in CCSDS time code A format (YYYY-MM-DDThh:mm:ssZ**).**

**ENDTIM** date and time of the end of the period for when the data is valid in CCSDS time code A format (YYYY-MM-DDThh:mm:ssZ**).**

**LF** is a single line-feed character (ASCII $0A_{hex}$).

**NREC** an internally used record identifier.

**DAYBEG** Modified Julian Date 2000 (MJD 2000, i.e. the date 0.0 refers to the 1st January 2000 at 0:00:00), of the start of the period for when the data is valid.

**DAYEND** Modified Julian Date 2000 (MJD 2000), of the end of the period for when the data is valid.

**EPOCH** Modified Julian Date 2000 (MJD 2000), of the epoch for the reference Kepler orbit.

**ORBIN** Revolution number for this epoch, counting start at perigee

**SMAXIS** Semimajor axis 'a', in km, of the reference Kepler orbit·

**OMOTIN** Inverse mean motion = 'a*sqrt(a/μ)' of the reference Kepler orbit in seconds/rad (μ = central Earth potential).

**NREC** an internally used record identifier.

**XYZPOS(3)** are the x-y-z components of the position vector in km of the reference Kepler orbit.

**XYZVEL(3)** are the x-y-z components of the velocity vector in km/s of the reference Kepler orbit.

**RDIST** is the absolute value 'r' of the position vector of the reference Kepler orbit in km.

| Rec ID> (I3) | <Polynomial coefficient of x-y-z components of position vector> (3F11.3) | <Polynomial coefficients of x-y-z components of velocity vector> (3F11.7) | LF (A1) |
|---|---|---|---|
| **RECID** | **POLPOS(3)** | **POLVEL(3)** | **LF** |

*Table E-3 Definition of a Coefficient Block within the Long Term Orbit File*

Where:

**RECID** an internally used record identifier.

**POLPOS(3)** are the polynomial coefficients of the x-y-z components of the position vector in km of the reference Kepler orbit.

**POLVEL(3)** are the polynomial coefficients of the x-y-z components of the velocity vector in km/s of the reference Kepler orbit.

**LF** is a single line-feed character (ASCII $0A_{hex}$)

Depending upon the accuracy required the number of the coefficient blocks will vary between 0 and 10 inclusive.

The coordinate system is the Inertial Mean Geocentric Equatorial System of year J2000.0, with the x-axis towards the mean vernal equinox, the x-y plane coinciding with the mean equatorial plane and the z-axis toward north. Time and coordinate systems used for orbital operations at ESOC are described in Ref. [13].

## E.2 : Short Term Orbit File (STOF)

The format of the short term orbit file is identical to that of the long term orbit file as defined in Appendix E.1 The difference between the files is the resolution and hence accuracy. In accordance with the mission baseline, the accuracy of the orbit determination is to within 5 km, further to this there may be an additional maximum error of 100 metres due to the use of the approximation method. The STOF will provide reconstituted data for the previous 10 days before generation, and 3.5 months of predicted orbit data from the day of generation. This file will be generated at least once per week. This file will also contain from 0 to 10 (inclusive) coefficient blocks.