**DATA QUALITY ASSURANCE CONTRACT ADDENDUM**

**SECTION 1**

**DEFINITIONS**

COMPANY: The operator of the well or wells for which CONTRACTOR is performing the work.

CONTRACT: The contract between COMPANY and CONTRACTOR into which these Data Quality Assurance Requirements are incorporated.

CONTRACTOR: Any contractor performing work for COMPANY who provides, installs, calibrates, rigs up, maintains, or repairs EQUIPMENT.

EQUIPMENT: Any system, machine, device, instrument, or tool that CONTRACTOR is contracted to provide under the CONTRACT.

KEY INSTRUMENT: Any EQUIPMENT that measures, reports/displays, collects, aggregates, or transmits data which is material to any well operation on an oil, gas, or injection well.

CRITICALITY LEVEL: Rating system for KEY INSTRUMENTS based on failure consequence

INSTRUMENT REDUNDANCY LEVEL: In case of duplicate sensors, the designation of which KEY INSTRUMENT is to be treated as primary and which are secondary (backup).

**SECTION 2**

**QUALITY CONTROL/ASSURANCE**

2.1 CONTRACTOR shall develop and maintain quality control/ assurance documentation regarding its internal quality processes/ standards for installation, rig up, operation, and maintenance of all EQUIPMENT. CONTRACTOR shall have management of change processes to ensure proper measures are taken prior to changes to EQUIPMENT in respect to hardware/ software. CONTRACTOR management of change process shall include notification to COMPANY of relevant changes. COMPANY may request modifications subject to mutual agreement with CONTRACTOR, not to be unreasonably withheld or delayed.

2.2 CONTRACTOR shall have a competency program to ensure personnel participating in testing and measurement shall be trained in the necessary skills involved in data generation and data management. This shall include initial and ongoing personnel training, testing, and verification of knowledge transfer.

2.3 CONTRACTOR shall utilize a self-monitoring and assessment system with key performance indicators (KPIs) and reporting to determine the extent to which requirements are being met. This system shall include the resolution of all problems found in the assessments, with plans and responsibilities for appropriate follow-up.

2.4 COMPANY retains the right to audit CONTRACTOR’s processes/standards and inspect EQUPMENT as required.

**SECTION 3**

**MINIMUM ACCURACY AND REPEATABILITY STANDARDS**

COMPANY and CONTRACTOR shall jointly define KEY INSTRUMENTS and the required minimum accuracy and repeatability.

**SECTION 4**

**RELIABILITY**

CONTRACTOR shall provide KEY INSTRUMENTS that ensure proper operation in the expected operating environment of the well site. KEY INSTRUMENTS shall demonstrate a minimum of uptime specification for the system and respective components (to be defined between COMPANY and CONTRACTOR). Any communication method (wired or wireless) that is part of the KEY INSTRUMENTS shall be considered in calculations of uptime. It is understood that resistance to weather and rough handling are typical oilfield design requirements. Allowances shall be made for extreme events (such as floods, tornado).

**SECTION 5**

**CALIBRATION AND FIELD VERIFICATION STANDARDS**

5.1 Calibration and field verification requirements and schedule will be defined by CONTRACTOR based on criticality level (failure consequence), instrument redundancy level (primary, secondary), and quality processes.

5.2 Calibration and field verification shall be performed according to a schedule set out in CONTRACTOR’s internal quality processes/ standards regarding each particular KEY INSTRUMENT. Results shall be made available to COMPANY prior to start of operations. COMPANY reserves the right to request more frequent verification and/ or calibration (for example, after rig up and before start of operations).

5.3 KEY INSTRUMENTS shall demonstrate precision, accuracy, and repeatability by adherence to CONTRACTOR’s processes regarding calibration. All KEY INSTRUMENTS shall be verified over the expected operating range.

5.4 Before any testing, calibration, or verification, CONTRACTOR shall supply a designated COMPANY representative with proof of accuracy and repeatability of testing tools with traceability, when requested, to NIST (National Institute of Standards) or other comparable standards institution. For new or factory reconditioned KEY INSTRUMENTS, FAT (Factory Acceptance Test) results may be provided to COMPANY as proof of accuracy.

5.5 COMPANY’s designated representative shall be notified immediately in the event that a KEY INSTRUMENT does not conform to CONTRACTOR’s standards/ processes.

5.6 CONTRACTOR shall document any KEY INSTRUMENT which is adjusted, scaled, or otherwise modified to conform to CONTRACTOR standards/ processes and shall provide details to COMPANY’s designated representative regarding the adjustment, scaling, or other modification.

**SECTION 6**

**DATA STORAGE AND TRANSMISSION (if applicable)**

6.1 CONTRACTOR represents and warrants that it is capable of storing data at intervals required by the CONTRACT. Data storage frequency shall be at the frequency of transmitted data or faster. Data retention requirements shall be defined by COMPANY and CONTRACTOR in cooperation. CONTRACTOR shall notify COMPANY not less than 30 days prior to deletion of data.

6.2 CONTRACTOR shall transmit data to COMPANY as accurately and securely as practicable in accordance with current industry practice by agreed communications protocol and data standards (ex: WITSML 1.3.1.1, WITSML 1.4.1.1, WITSML 2.0, rest API, etc.) meeting or exceeding those specified by COMPANY. CONTRACTOR shall make its best efforts to have data transmission available at all time.

6.3 CONTRACTOR shall advise COMPANY of all data streams available for real time transmission or recorded in memory. CONTRACTOR shall electronically transmit all available real time surface and/ or downhole data as specified by COMPANY. In addition, CONTRACTOR shall provide all agreed upon memory data to COMPANY in a usable format, within agreed upon specified time after finishing the job.

**SECTION 7**

**DATA TRANSFORMATION**

7.1 All measurements such as pressure, flow rate, density, etc should include instantaneous readings and not just averaged or smoothed over time.

7.2 At the request of COMPANY, CONTRACTOR shall provide a list of scan/ poll rates, along with data transmission rates, for all measured, calculated, and transmitted data streams.

7.3 Upon execution of the CONTRACT, CONTRACTOR shall, with the exception of proprietary formulas, make available to COMPANY all information regarding methods of filtering, sampling, smoothing, decimation, or other modifications applied, for any reason, to data within and from any KEY INSTRUMENT which alter the data that the KEY INSTRUMENT normally provides.

7.4 CONTRACTOR shall also make available to COMPANY for all agreed upon data streams related to the control of the operation, including, but not limited to, any and all set points, loop-in control, and sensitivity settings.

**SECTION 8**

**INTEROPERABILITY AND DATA INTEGRATION**

**8.1 Time Synchronization**

8.1.1 CONTRACTOR shall time synchronize the setting of all KEY INSTRUMENTS provided by CONTRACTOR used for data aggregation, collection, and transmission to a COMPANY-specified time server as specified in COMPANY’s published recommended practice (e.g. hourly, daily). (Best practice is to use atomic time.)

8.1.2 CONTRACTOR shall deliver downhole recorded data corrected back to the time and the depth at which it was originally measured.

8.1.3 CONTRACTOR shall similarly time synchronize all downhole tools to the same COMPANY-specified time server before such downhole tools are run in the hole. Upon being returned to the surface, the time system of all downhole tools shall be compared against the COMPANY-specified time server and CONTRACTOR shall provide to COMPANY the observed time offsets.

8.1.4 CONTRACTOR shall provide surface and downhole datasets recorded against CONTRACTOR’S originally recorded time system and shall, in the event time offsets from the COMPANY-specified server have been observed, also provide similar datasets but with time stamps corrected for the observed offsets from the COMPANY-specified time server in such a manner as to correct all time recorded data back to a master time, that of the COMPANY-specified time server. If time stamp corrected data is provided, CONTRACTOR shall provide assumption for time correction.

**8.2 Mnemonics and Units of Measure Standardization**

8.2.1 Mnemonics for data transmission shall be agreed upon between COMPANY and CONTRACTOR for consistency.

8.2.2 The data transmitted shall be expressed in the standard units defined by COMPANY and agreed upon with CONTRACTOR.

**Exhibit 1 – Drilling Rig Specific Accuracy Requirements**

Example of potential KEY INSTRUMENT readings for drilling operations and their respective requirements.

|  |  |  |
| --- | --- | --- |
| **KEY INSTRUMENT reading** | **United States Customary System (USCS)** | **Metric** |
| Surface Rotary and Joint Makeup/Breakout Torque | +/-10% of full scale or +/-2000 ft-lb, whichever is less | +/-10% of full scale or +/-2700 N-m, whichever is less |
| Hookload | +/- 5000 lbs | +/- 2300 metric tons |
| Rotary Surface Rotational Speed | +/- 2 RPM | +/- 2 RPM |
| Stand Pipe Pressure | +/-1% of full scale or 100 psi, whichever is less | +/-1% of full scale or 700 kPa, whichever is less |
| Drilling Fluid Pump Rate | +/- 10 gpm (system net) | +/- 0.04 m3/min (system net) |
| Drilling Fluid Tank/Pit Volume | +/-1 bbl or +/-1% of pit/section vol, whichever is less | +/-0.16 m3 or +/-1% of pit/section vol, whichever is less |
| Drilling Fluid Density | +/- 0.1 ppg | +/- 12 kg/m3 |
| Drilling Fluid Viscosity | +/- 5 cp | +/- 0.005 Pa-s |
| Block Position | +/-1 ft; 0.5% of total distance | +/-0.3 m; 0.5% of total distance |

COMPANY and CONTRACTOR shall document KEY INSTRUMENTS and their accuracy and resolution requirements.

|  |  |  |
| --- | --- | --- |
| Key Instrument | Accuracy requirement | Resolution requirement |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |

Units:

* m = meter
* m3 = cubic meters
* m3/min = cubic meters per minute
* N-m = newton-meter
* Pa-s = Pascal seconds
* ppg = pounds per gallon
* psi = pounds per square inch
* bbl = barrel
* cp = centipoise
* ft = feet
* ft-lb = foot-pound
* gpm = gallons per minute
* kg/m3 = kilograms per cubic meter
* kPa = kilopascals
* lbs = pounds

**Exhibit 2 – Well Stimulation Specific Accuracy Requirements**

Example of potential KEY INSTRUMENTS for completion operations and their respective requirements.

|  |  |  |
| --- | --- | --- |
| **KEY INSTRUMENT reading** | **United States Customary System (USCS)** | **Metric** |
| Treating Pressure | +/-1% of full scale | +/-1% of full scale |
| Annulus Pressure | +/-1% of full scale | +/-1% of full scale |
| Slurry or Clean Rate | +/-0.5% over standard flow range | +/-0.5% over standard flow range |
| Density | +/- 0.1 ppg | +/- 12 kg/m3 |
| Proppant Concentration | +/- 0.2 ppa | +/- 0.2 kgPA |
| Dry Additive Rate | +/- 0.1 ppa | +/- 0.1 kgPA |
| Liquid Additive Rate | +/- 0.1 gpm | +/- 0.4 L/min |

COMPANY and CONTRACTOR shall document KEY INSTRUMENTS and their accuracy and resolution requirements.

|  |  |  |
| --- | --- | --- |
| Key Instrument | Accuracy requirement | Resolution requirement |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |

Units:

* gpm = gallons per minute
* kg/m3 = kilograms per cubic meter
* kgPA = kg of proppant in cubic meter of stimulation fluid
* L/min = liters per minute
* ppa = pounds of proppant (or dry product) added per 1000 gallons of stimulation fluid
* ppg = pounds per gallon

**Exhibit 3 – Completions Data Requirements Example**

Example: Data collection frequency will be at least one reading every second.

Example: Post job – file delivery example

Data files

1. Files will be named per operators file naming requirements.
2. File format will be per agreed upon operator and completion vendor header naming standard for required data fields (such as date/time, treating pressure, slurry flow rate, clean rate, proppant concentrations, chemical concentrations, coiled tubing pressure, wireline speed, tension, reel speed, etc).
	1. Units as agreed upon
	2. No duplicate headers
	3. No commas in headers
3. At agreed upon time (ex: end of each frac stage, within 2 days of job end date), a file will be exported and sent to operator.

Example: Well Stimulation specific requirements

Proper identification of the start and end stage is required.

* + 1. For single files per stage, the start of the stage is prior to starting rate, and the end of stage is after the minimum shut-in time. Stage identification is based on the filename.
		2. For multiple stages per file (stage identification will be in per a stage column)
			- 1. Start of stage will be the end of the prior stage
				2. End of stage

for stages with a shut-in, the end will be prior after the minimum shut-in time and prior to start of rate on the following stage.

for stages without a shut-in, the end will be after BH proppant for the stage has cleared the perforation and prior to start of proppant for the following stage.

Instantaneous Shut In Pressure (ISIP) and water hammer analysis (Well Stimulation)

* + 1. For frac stages where there is an end of stage rate shutdown and an ISIP calculation is required by the company, a minimum shut-in time is required.  Do not bleed off pressure prior to the minimum shut-in time.
		2. During the shut-in, ensure the right pressure measurement is being recorded to capture the fall off pressure.  (Please note there may be pressure instrumentation located upstream and downstream of valves used to isolate surface equipment from well pressures or to prevent flow back to surface equipment (such as check valves).  Ensure the pressure reading being recorded is downstream of the isolating valve/check valves and is capturing the well pressure which will be the fall off pressure during the shutdown.)
		3. For the data pull for the CSV file, it is required to pull data to include the minimum shut-in time.
		4. During the shut-in (pressure fall off period), flow readings recorded should only reflect rate being pumped down the casing.
		5. Value of ISIPs:  Instantaneous Shut-In Pressures
			1. ISIPs are valuable pieces of information that can be used to characterize the stress regime (in-situ and altered) as well as fracture dimensions.
			2. For instance, the ISIP of the toe-most stage is used to calculate net fracturing pressure. The escalation of ISIPs during the first few stages is then analyzed to calculate an average hydraulic height for the given well.
			3. Finally, ISIPs can be used to quantify stress changes caused by depletion, refracturing, and the sequencing of fracturing operations across multiple wells, and hence help optimizing multi-well spacing/sequencing.
		6. For water hammer analysis, consistent step down is required for comparison. (ex: last step rate to be held for 30 seconds before full shut-in)-consistent rate