Table 2 — Customer Data Requirements for CSR - TDE-LF™

What information is required from the customer?

The implementation level depends on the quality, depth and availability of plant data. The matrix below shows what is typically needed for each TDE-LF™ deployment level.

Legend:

● Required ◐ Recommended ○ Optional — Not required

Required input from customer	Offline Simulator	DSS / Advisory Mode	Online Digital Twin
Basic LF plant data (ladle furnace size, transformer power, ladle capacity, main equipment, heating system)	●	●	●
General LF process description (heating practice, alloying practice, slag conditioning, stirring logic, treatment philosophy)	●	●	●
Typical operating values (arrival temperature, target tapping temperature, treatment duration, alloy additions, stirring practice)	●	●	●
Standard recipes / operating practice	●	●	●
Historical treatment results (final temperature, final chemistry, power consumption, alloy consumption, treatment time)	◐	●	●
Heat-by-heat / treatment-by-treatment production data	○	●	●
Time-stamped process sequence (power-on/off, alloy additions, wire feeding, slag additions, stirring events, temperature measurements, sampling events)	○	◐	●
Actual process measurements during operation	○	●	●
Temperature measurement data	◐	●	●
Chemistry and sampling data	◐	●	●
Argon stirring / gas flow data	○	◐	●
Electrical operating data (power, voltage, current, transformer settings, energy consumption)	◐	●	●
Alloy addition and wire feeding data	○	●	●
Slag practice data (if available)	○	◐	●
Ladle refractory design data (working lining, safety lining, bottom and slag line zoning, material grades, nominal thickness)	◐	◐	●

Required input from customer	Offline Simulator	DSS / Advisory Mode	Online Digital Twin
Ladle campaign history and refractory consumption records	○	◐	●
Repair, patching and gunning records (if available)	○	◐	●
Shell temperature / ladle thermal map data (if available)	○	◐	●
Slag chemistry history relevant to ladle refractory attack (if available)	○	◐	●
List of available data sources (Excel, CSV, historian, database, Level 2, etc.)	◐	●	●
Live signal availability	—	○	●
PLC / Level 1 / Level 2 tag list	—	○	●
Tag description and engineering units	—	○	●
Data communication architecture (OPC-UA, database, API, historian, network constraints)	—	◐	●
Automation sequence and phase logic	—	○	●
IT / OT environment and deployment constraints	—	○	●
Customer expectations and project objectives	●	●	●

TDE-LF™ can start as an Offline Simulator and progressively evolve into DSS / Advisory Mode and a fully integrated Online Digital Twin as plant data availability increases.

Note on data quality and consistency

The quality of TDE™ outputs depends on the accuracy, completeness, time alignment and engineering consistency of the data provided by the customer. Whenever available, data should be supplied with clear units, time stamps, signal descriptions, process phase references and indication of measurement source. Inaccurate, incomplete or non-synchronized data may still allow a preliminary implementation, but with reduced predictive strength and advisory precision.

Note on refractory-related analyses

Refractory optimization, lining wear interpretation, campaign life support and slag/refractory interaction assessment can be significantly improved when the customer provides refractory design data, lining zoning, material grades, campaign history, repair records, shell temperature information, hot spot history and refractory consumption records.