Table 1 — TDE-Vacuum™ (RH) Implementation Levels

TDE-Vacuum™ (RH) can be deployed at three progressive implementation levels, depending on the customer's objectives, available data and desired degree of plant integration.

Integration level:

● Full live integration **◐ Partial / advisory integration** **— No live integration required**

Version	Main purpose	Typical use	Plant integration	Expected output
Offline Simulator	Process study and scenario evaluation	What-if analysis, vacuum treatment studies, degassing assessment, thermal evaluation, training, benchmarking	**— No live plant connection required**	Simulated treatment trends, thermal and metallurgical analysis, comparison of operating strategies
DSS / Advisory Mode	Decision support during RH treatment	Operator guidance, degassing assessment, treatment review, temperature and chemistry adjustment support, deviation interpretation	**◐ Historical, exported or semi-live plant data**	Recommendations, warnings, process interpretation, support for treatment decisions
Online Digital Twin	Real-time synchronized process representation	Live monitoring, predictive supervision, vacuum treatment tracking, digital twin deployment	**● Integrated with live plant signals and automation architecture**	Real-time tracking, predicted process evolution, dynamic advisory output, synchronized digital process view

Each level corresponds to a different operational scope, from offline engineering analysis to real-time synchronized process intelligence.