I. Summary

The NEXTECH Series (R and E) Trunnion Ball Valve [bare stem], TRUNTECH Series 3-Piece Trunnion Ball Valve [bare stem], the V1 Series (V1-1,-2,-3, -4) Floating Ball Valve [bare stem] and the ERV (V1) Floating Ball Valve [bare stem] assemblies are confirmed to be IEC61508:

- **Type A**
- **Hardware Route 2H Device**
- **Systematic safety integrity: Route 2S**
- **Low Demand Mode operation (not more than one demand per year)**
- **Architectural constraint ED2:2010, Route 2H: HFT= 1 for SIL-3.**

Valve population: predominantly in Open to Close movement.

The PFDavg and Architecture Constraints must be verified for each application.

Sizes: 1"–48", Pressure classes: 1" - 48": ASME #150–1" - 48": ASME #2500; 2" - 12": API 10,000, or equivalent API classes. IEC61508:ED2 2010:

Process service duty: SEVERE UNCLEAN [UPSTREAM] DUTY CLASS NU-NAVAL UNSHELTERED; this includes the lighter Clean process service duty class NU. Naval Unsheltered (non-protected surface ship borne equipment exposed to weather conditions).

Table 1: Summary Demonstrated Field Performance Route 2H – SAR – Safety Analysis Reliability Values

	MTBF_Dangerous		Failure Rate_D			MTBF_Dangerous		FAILURE RATE_D	
	MINIMUM	AVERAGE	AVERAGE	MAXIMUM		MINIMUM	AVERAGE	AVERAGE	MAXIMUM
ASPECT Full Stroke Failure	[year]	[year]	[1/hour]	[1/hour]	**ASPECT TSO-Tight Shut Off Failure**	[year]	[year]	[1/hour]	[1/hour]
ALL DUTIES-MIN, ALL FS, sizes >=2"	2345	2855	4.00E-08	4.87E-08	**ALL DUTIES-MIN, ALL TSO, sizes >=2"**	1153	1321	8.64E-08	9.90E-08
ALL DUTIES, FS AGREED DUTY, sizes >=2"	3815	4918	2.32E-08	2.99E-08	ALL DUTIES, TSO AGREED DUTY, sizes >=2"	1397	1624	7.03E-08	8.17E-08
NORMAL DUTY-MIN, sizes >=2"	2743	8217	1.39E-08	4.16E-08	**NORMAL DUTY-MIN, sizes >=2"**	1305	2739	4.17E-08	8.75E-08
SEVERE UNCLEAN-MIN, sizes >=2"	1273	3019	3.78E-08	8.97E-08	**SEVERE UNCLEAN-MIN, sizes >=2"**	660	1208	9.45E-08	1.73E-07
All failures FS, all ops years, all sizes	14656	17846	6.40E-09	7.79E-09	All failures TSO, all ops years, all sizes	7204	8257	1.38E-08	1.58E-08
Confidence level (1-alfa): 90.0%	DIACUSA-VTI-2017-081-R3B4_UC-NXTRNTECH.xlsm				Confidence level (1-alfa): 90.0%				
Fnp: assumed demands per year	Fnp	1.00E+00	[1/year]		Fnp: assumed demands per hour	Fnp	1.14E-04	[1/hour]	

Route 1H: Automated FST with instrumentation, DCF> 90%, SFF> 90%; automated Level 3 PST, ISA-TR96.05.01-2017, 'Partial Stroke Testing of Automated Valves' (see Lit. 10), DCF>= 60%; DCF and SFF conditional to IEC61508-ED2 constraints for Route 1H definition of DCF and to repair within MTTR (Ch.8).

Useful life: stated in Safety Manuals in place with effect, minimum the agreed Shut-Down Maintenance interval (for Severe Unclean process service duty); mission life for Clean process service duties useful life can extend well beyond 10 years. Mission life in Design Review: 10 years.

Systematic Failures comply with minimum SIL-3.
Safety Manuals and IOM Manuals are in place with effect (Installation, Operation, and Maintenance).

Probabilistic SIL Calculation of benchmark SIS's: Probabilistic SIL-3 is achieved both in HFT= 0 and HFT= 1(see Appendix G).

For the SIL Certificate to be valid it is mandatory that transport, construction, operation, inspection and maintenance are in full compliance with manufacturer's requirements.

For SIL-2 and above safety-related services after dis-assembly, assembly, repair and/ or modification of the valve: manufacturer's certification is required to ensure the valve is in full manufacturer's compliance for designated safety-related duties.

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DEPENDABLE
Industrial Automation Consultancy USA LLC

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