Certificate

No.: 968/V 1058.01/23

Product tested	Pilot operated Solenoid Valves	**Certificate holder**	Power-Genex, Ltd. 99, Eunbong-ro Namdong-gu Incheon, 21639 Republic of Korea
Type designation	ESV series		
Codes and standards	IEC 61508 Parts 1-2 and 4-7:2010		
Intended application	Safety Function: On demand of the safety function or de-energising of the power supply the solenoid valve will move to its fail-safe position. The valves are suitable for use in a safety instrumented system (e.g. acc. to IEC 61511-1) up to SIL 2 (low demand mode). Under consideration of the minimum required hardware fault tolerance HFT = 1 for the complete final element the valves may be used up to SIL 3.		
Specific requirements	The instructions of the associated Installation, Operating and Safety Manual shall be considered.		

Summary of test results see back side of this certificate.

Valid until 2028-02-14

The issue of this certificate is based upon an evaluation in accordance with the Certification Program CERT FSP1 V1.0:2017 in its actual version, whose results are documented in Report No. 968/V 1058.01/23 dated 2023-02-02. This certificate is valid only for products, which are identical with the product tested. Issued by the certification body accredited by DAkkS according to DIN EN ISO/IEC 17065. The accreditation is only valid for the scope listed in the annex to the accreditation certificate D-ZE-11052-02-01.

TÜV Rheinland Industrie Service GmbH
Bereich Automation
Funktionale Sicherheit
Am Grauen Stein, 51105 Köln

Köln, 2023-02-14	Certification Body Safety & Security for Automation & Grid	Dipl.-Ing. (FH) Wolf Rückwart

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Holder: Power - Genex Ltd.
99 Eunbong-ro, Namdong-gu
Incheon, 21639
Republic of Korea

Product tested: **ESV series solenoid valves**

Results of Assessment

Route of Assessment		2_H / 1_S
Type of Sub-system		Type A
Mode of Operation		Low Demand Mode
Hardware Fault Tolerance	HFT	0
Systematic Capability		**SC 3**

When de-energised, the solenoid valve goes to its fail safe position - Single acting (spring return)

Dangerous Failure Rate	λ_D	1.84 E-07 / h	**184 FIT**
Average Probability of Failure on Demand 1oo1	$PFD_{avg}(T_1)$	8.19 E-04	
Average Probability of Failure on Demand 1oo2	$PFD_{avg}(T_1)$	8.26 E-05	

When de-energised, the solenoid valve goes to its fail safe position - Double acting (pressure force)

Dangerous Failure Rate	λ_D	2.58 E-07 / h	**258 FIT**
Average Probability of Failure on Demand 1oo1	$PFD_{avg}(T_1)$	1.15 E-03	
Average Probability of Failure on Demand 1oo2	$PFD_{avg}(T_1)$	1.16 E-04	

Assumptions for the calculations above: DC = 0 %, T_1 = 1 year, MRT = 72 h, β_{1oo2} = 10 %

Origin of failure rates

The stated failure rates for low demand are the result of an FMEDA with tailored failure rates for the design and manufacturing process.
Furthermore the results have been verified by qualification tests and field-feedback data.
Failure rates include failures that occur at a random point in time and are due to degradation mechanisms such as ageing.
The stated failure rates do not release the end-user from collecting and evaluating application-specific reliability data.

Periodic Tests and Maintenance

The given values require periodic tests and maintenance as described in the Safety Manual.
The operator is responsible for the consideration of specific external conditions (e.g. ensuring of required quality of media, max. temperature, time of impact), and adequate test cycles.